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ABSTRACT

This packet of four learning modules on drawing is one of 20 such packets developed for apprenticeship training for stationary engineers. Introductory materials are a complete listing of all available modules and a supplementary reference list. Each module contains some or all of these components: goal, performance indicators, study guide (a checklist of steps the student should complete), an introduction, information sheets, a vocabulary list, assignment sheet, job sheet, self-assessment, self-assessment answers, post-assessment, and instructor post-assessment answers. The four training modules cover types of drawings and views, blueprint reading/working drawings, scaling and dimensioning, and machine and welding symbols. (YLB)

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ED254697

APPRENTICESHIP

STATIONARY ENGINEERS

RELATED TRAINING MODULES

3.1 - 3.4 DRAWING

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APPRENTICESHIP

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5.4 Basics of Direct Current
5.5 Introduction to Circuits
5.6 Reading Scales
5.7 Using a V.O.M.
5.8 OHM'S Law
5.9 Power and Watt's Law
5.10 Kirchoff's Current Law
5.11 Kirchoff's Voltage Law
5.12 Series Resistive Circuits
5.13 Parallel Resistive Circuits
5.14 Series - Parallel Resistive Circuits

5.15 Switches and Relays
5.16 Basics of Alternating Currents
5.17 Magnetism

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6.2 Feedback
6.3 Individual Strengths
6.4 Interpersonal Conflicts
6.5 Group Problem Solving, Goal-setting and Decision-making
6.6 Worksite Visits
6.7 Resumes
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6.9 Work Habits and Attitudes
6.10 Wider Influences and Responsibilities
6.11 Personal Finance
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7.6 Percent
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7.8 Ratio and Proportion
7.9 Perimeters, Areas and Volumes
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8.3 Hydraulics - Symbols
8.4 Hydraulics - Basic Systems
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8.7 Hydraulics - Reservoirs
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12.7 Boilers - Heat Recovery Systems
12.8 Boilers - Instruments and Controls
12.9 Boilers - Piping and Steam Traps

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21.1 Circuit Protection
22.1 Installation - Foundations
22.2 Installation - Alignment
23.1 Trade Terms

STATIONARY ENGINEER
SUPPLEMENTARY REFERENCE DIRECTORY

Note: All reference packets are numbered on the upper right-hand corner of the respective cover page.

Supplementary Packet #	Description	Related Training Module
12.1	Correspondence Course, Lecture 1, Sec. 2, Steam Generators, Types of Boilers I, S.A.I.T., Calgary, Alberta, Canada	12.1 Boilers, Fire Tube Type
12.2	Correspondence Course, Lecture 2, Sec. 2, Steam Generators, Types of Boilers II, S.A.I.T., Calgary, Alberta, Canada	12.2 Boilers, Water Tube Type
12.3	Correspondence Course, Lecture 2, Sec. 2, Steam Generators, Boiler Construction & Erection, S.A.I.T., Calgary, Alberta, Canada	12.3 Boilers, Construction
12.4	Correspondence Course, Lecture 4, Sec. 2, Steam Generators, Boiler Fittings II, S.A.I.T., Calgary, Alberta, Canada	12.4 Boilers, Fittings
12.4	Corresondence Course, Lecture 4, Sec. 2, Steam Generators, Boiler Fitting I, S.A.I.T., Calgary, Alberta, Canada	12.4 Boilers, Fittings
12.5	Correspondence Course, Lecture 10, Sec. 2, Steam Generation, Boiler Operation, Maintenance, Inspection, S.A.I.T., Calgary, Alberta, Canada	12.5 Boilers, Operation
12.7	Correspondence Course, Lecture 3, Sec. 2, Steam Generation, Boiler Details, S.A.I.T., Calgary, Alberta, Canada	12.7 Boilers Heat Recovery Systems
12.8	Refer to reference packet 14.3/12.8	
		PUMPS
13.1	Correspondence Course, Lecture 9, Sec. 2, Steam Generator, Power Plant Pumps, S.A.I.T., Calgary, Alberta, Canada	13.1 Types & Classification
13.2		13.2 Applications
13.4		13.4 Calculating Heat & Flow
13.6		13.6 Monitoring & Troubleshooting
13.7		13.7 Maintenance
13.3	Correspondence Course, Lecture 6, Sec. 3, Steam Generators, Pumps, S.A.I.T., Calgary, Alberta, Canada	13.3 Construction
13.5		13.5 Operation

Supplementary Packet #	Description	Related Training Module
14.3 12.8	Correspondence Course, Lecture 6, Section 3, Steam Generators, Steam Generator Controls, S.A.I.T., Calgary, Alberta, Canada	14.3 Steam, Transport 12.8 Boilers, Instruments & Controls
14.4	Correspondence Course, Lecture 11, Section 2, Steam Generators, Piping II, S.A.I.T., Calgary, Alberta, Canada	14.4 Steam, Purification
15.1	Correspondence Course, Lecture 1, Sec. 4, Prime Movers & Auxiliaries, Steam Turbines, S.A.I.T., Calgary, Alberta, Canada	15.1 Steam Turbines, Types
15.2	Correspondence Course, Lecture 4, Sec. 3, Prime Movers, Steam Turbines I, S.A.I.T., Calgary, Alberta, Canada	15.2 Steam Turbines, Components
15.3	Correspondence Course, Lecture 2, Sec. 4, Prime Movers & Auxiliaries, Steam Turbine Auxiliaries, S.A.I.T., Calgary, Alberta, Canada	15.3 Steam Turbines, Auxiliaries
15.4	Correspondence Course, Lecture 6, Sec. 3, Prime Movers, Steam Turbine Operation & Maintenance, S.A.I.T., Calgary, Alberta, Canada	15.4 Steam Turbines, Operation & Maintenance
15.5	Correspondence Course, Lecture 8, Sec. 3, Prime Movers, Gas Turbines, S.A.I.T., Calgary, Alberta, Canada	15.5 Gas Turbines
16.2	Boilers Fired with Wood and Bark Residues, D.D. Junge, F.R.L., O.S.U. 1975	16.2 Combustion Types of Fuel
16.2	Correspondence Course, Lecture 5, Sec. 2, Steam Generators, Fuel Combustion, S.A.I.T., Calgary, Alberta, Canada	16.2 Combustion Types of Fuel
16.3	Correspondence Course, Lecture 5, Sec. 2, Plant Services, Fuel & Combustion, S.A.I.T., Calgary, Alberta, Canada	16.3 Combustion, Air & Fuel Gases
17.1	Correspondence Course, Lecture 12, Sec. 3, Steam Generation, Water Treatment, S.A.I.T., Calgary, Alberta, Canada	17.1 Feed Water, Types & Operation
17.2	Correspondence Course, Lecture 12, Sec. 2, Steam Generation, Water Treatment, S.A.I.T., Calgary, Alberta, Canada	17.2 Feed Water, Water Treatments

Supplementary Packet #	Description	Related Training Module
17.3	Correspondence Course, Lecture 7, Sec. 2, Steam Generators, Boiler Feed Water Treatment, S.A.I.T., Calgary, Alberta, Canada	17.3 Feed Water, Testing
18.1	Correspondence Course, Lecture 2, Sec. 5, Electricity, Direct Current Machines, S.A.I.T., Calgary, Alberta, Canada	18.1 Generators, Types & Construction
18.1 18.2	Correspondence Course, Lecture 4, Sec. 5, Electricity, Alternating Current Generators, S.A.I.T., Calgary, Alberta, Canada	18.1 Generators, Types & Construction 18.2 Generators, Operation
19.1	Correspondence Course, Lecture 5, Sec. 4, Prime Movers & Auxiliaries, Air Compressor I, S.A.I.T., Calgary, Alberta, Canada	19.1 Air Compressors, Types
19.1 19.2	Correspondence Course, Lecture 6, Sec. 4, Prime Movers & Auxiliaries, Air Compressors II, S.A.I.T., Calgary, Alberta, Canada	19.1 Air Compressors, Types 19.2 Air Compressors, Operation & Maintenance
20.1	Basic Electronics, Power Transformers, EL-BE-51	20.1 Transformers
21.1	Correspondence Course, Lecture 7, Sec. 5, Electricity, Switchgear & Circuit, Protective Equipment, S.A.I.T., Calgary, Alberta, Canada	21.1 Circuit Protection
22.1	Correspondence Course, Lecture 10, Sec. 3, Prime Movers, Power Plant Erection & Installation, S.A.I.T., Calgary, Alberta, Canada	22.1 Installation Foundations

RECOMMENDATIONS FOR USING TRAINING MODULES

The following pages list modules and their corresponding numbers for this particular apprenticeship trade. As related training classroom hours vary for different reasons throughout the state, we recommend that the individual apprenticeship committees divide the total packets to fit their individual class schedules.

There are over 130 modules available. Apprentices can complete the whole set by the end of their indentured apprenticeships. Some apprentices may already have knowledge and skills that are covered in particular modules. In those cases, perhaps credit could be granted for those subjects, allowing apprentcies to advance to the remaining modules.

We suggest the the apprenticeship instructors assign the modules in numerical order to make this learning tool most effective.

SUPPLEMENTARY INFORMATION

ON CASSETTE TAPES

Tape 1: Fire Tube Boilers - Water Tube Boilers and Boiler Manholes and Safety Precautions

Tape 2: Boiler Fittings, Valves, Injectors, Pumps and Steam Traps

Tape 3: Combustion, Boiler Care and Heat Transfer and Feed Water Types

Tape 4: Boiler Safety and Steam Turbines

NOTE: The above cassette tapes are intended as additional reference material for the respective modules, as indicated, and not designated as a required assigrment.

3.1

TYPES OF DRAWINGS AND VIEWS

Goal:

The apprentice will be able to identify types of drawings and views.

Performance Indicators:

1. Identify orthographic protections.
2. Identify types of lines.
3. Identify perspective drawings.
4. Identify pictorial drawings.
5. Identify axonometric drawings.
6. Identify isometric drawings.

Study Guide

For successful completion of this module, complete the tasks in the order listed below. Check each one off as you complete it.

1. ____ Read the Goal and Performance Indicators on the cover of this module. This will explain what you can be expected to learn from the module and how you will demonstrate it.

2. ____ Read the Introduction section and study the Information section. In these sections you will acquire the knowledge necessary to pass the Self and Post Assessment exams.

3. ____ Complete the required assignments on the Assignment pages. Turn them in to your instructor for review.

4. ____ Complete the Self Assessment exam. This will show how well you can expect to do on the Post Assessment exam. Compare your answers with those on the Self Assessment Answer Sheet found immediately following the exam. If you scored poorly, re-study the Information section or ask your instructor for help.

5. ____ Complete the Post Assessment exam. Turn the answers in to your instructor. It is recommended you score 90% or better before continuing with the next module.

Introduction

One of the problems in all drawing is how to depict a three-dimensionsal object on a two-dimensional sheet of paper. Any attempt at showing all three dimensions on a single drawing will result in foreshortened lines that will not represent true dimensions of the object. To show an object's true shape, the draftsperson must make two or more related drawings, each of which depicts the object in two of its principal dimensions only--width and depth, width and height, or height and depth. Almost without exception, working drawings are made this way.

Sometimes, however, it is desirable to portray the object more nearly as an observer would normally see it--that is, to show all three principal dimensions at once. Several methods are employed for making drawings of this picture-like type, and all are useful for illustrating the overall shape and general features of technical objects. However, all of these pictorial drawing methods have a common disadvantage that makes them generally unsuitable for the production of working drawings: the true measurements of the object.

Information

ORTOHOGRAPHIC PROJECTION

The drawing method almost universally employed in the making of architectural and engineering working drawings is called orthographic projection; the drawings produced in this way are called orthographic or "true" drawings, as opposed to the picture-like drawings made by pictorial drawing methods. Unlike most pictorial drawings, orthographic drawings are drawn to scale, and true measurements can be taken from them.

An orthographic view shows one face or side of an object to the extent that it would be seen by an observer looking squarely at that side or face. No pictorial techniques are employed for an orthographic drawing, the object being shown in its actual form, not is apparent form. This makes it possible for the draftsperson to indicate, in a series of related orthographic views, the true size, shape, and location of every part of the object and to present dimensions in a clear and precise way.

VISUALIZING THE OBJECT FROM ORTHOGRAPHIC WORKING DRAWINGS

The orthographic-projection drawing method (also called "three-view" or "multiview" drawing) can best be understood from a study of the three most common orthographic views--top, front, and side views--as they are employed in mechanical drawings to represent a simple object, as for example in Fig. F-13.

Each of the three orthographic viewsin Fig. F-13 reveals the shape of the object as perceived from a particular viewing direction. Collectively, the three views provide a complete illustration of the object. The top view shows it in width and depth. The front view, which is obtained by rotating the object 90° on its vertical axis away from the front view, shows it in height and depth. If additional orthographic views are required to complete the description of an object, they will be developed by further 90° rotations, and thus will will bear right-angle relationships to the

top, front, and side views. Front, side, and rear views are called elevations. Hidden features are indicated on orthographic drawings by means of dotted lines, as in the front and side views in Fig. F-14.

In an orthographic drawing, only those object lines that are perpendicular to the observer's direction of view--that is, parallel with the picture plane--are shown in their true scale length. The oblique line A-B is drawn in true proportion in the top view in Fig. F-15. In the front view, however, the line A-B is drawn shorter than its true scale length and therefore is not shown in true proportion.

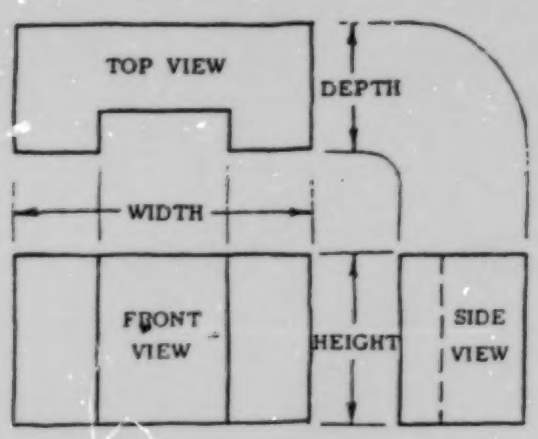
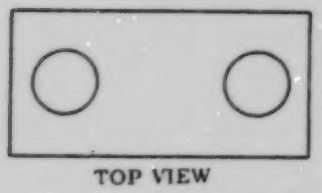


Fig. F 13
Orthographic (multiview) projections



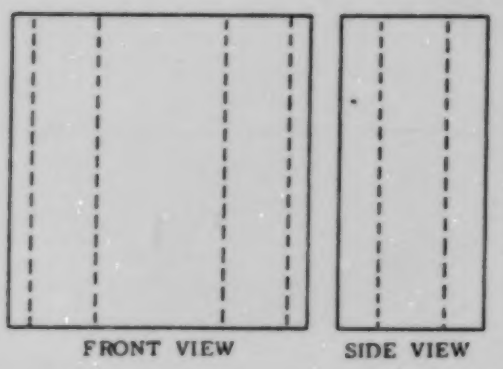
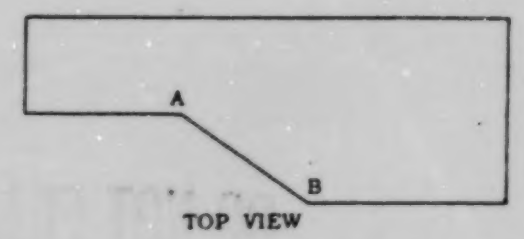


Fig. F-14
Hidden lines in orthographic views



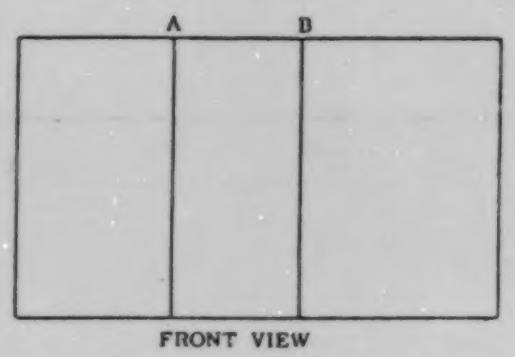


Fig. F-15
Oblique lines in orthographic projection

From this discussion, it will be seen that the shape of an object cannot be visualized from a single orthographic view; all the related views must be studied together. The importance of this rule will become apparent as more complex working drawings are encountered.

TYPES OF LINES IN WORKING DRAWINGS

Several types of lines, each having a specific meaning, are employed in the making of working drawings; some lines are thicker than others, some are solid, and some are broken. Some of the more common types of lines with an example of their application, are shown in Fig. F-16. Such a listing of conventional drafting lines is called an "alphabet of lines."

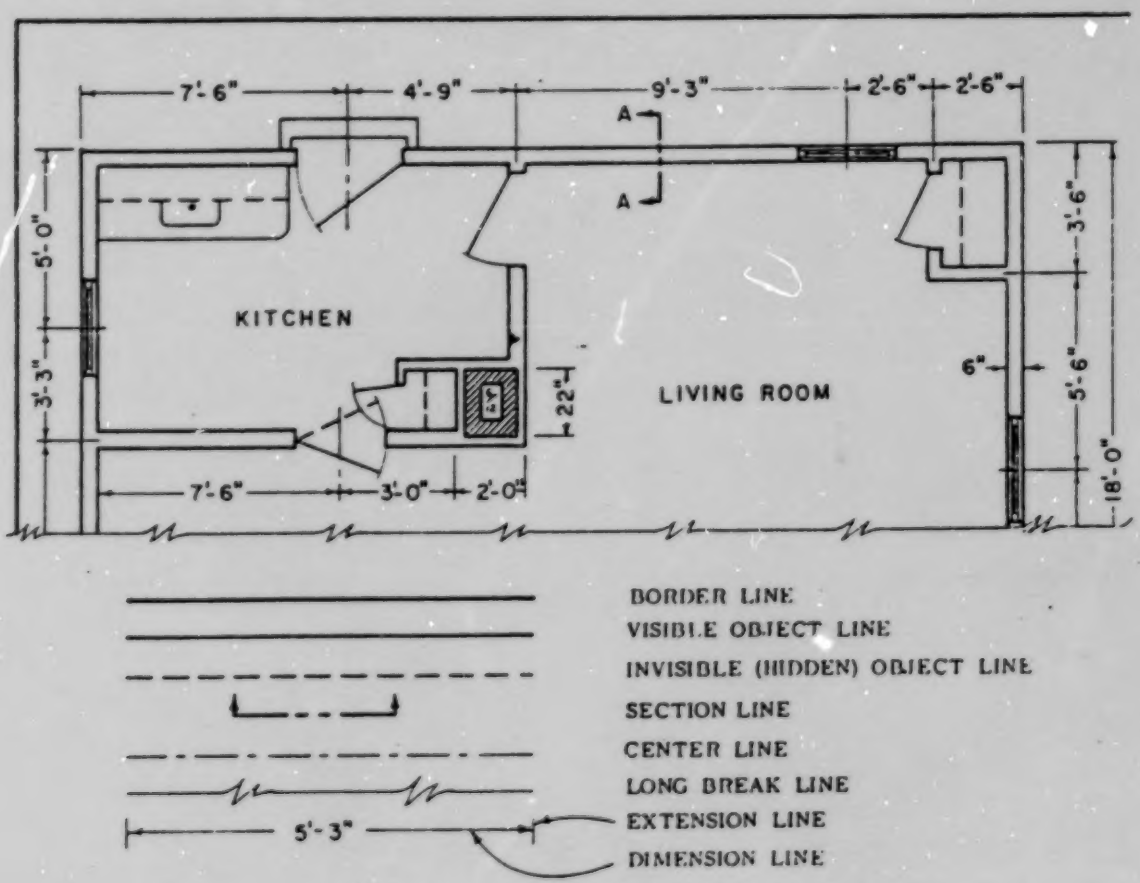


Fig. F-16. Lines used in working drawings.

PICTORIAL DRAWINGS

Because a pictorial drawing shows more than one face of the object, it can give more information about the shape of the object than would be possible with any single orthographic view. For this reason, persons without technical training find pictorial drawings the easier type to understand. The main disadvantage of pictorial drawings lies in their distortion of true object lines and angles; this makes them unsatisfactory for describing complete and detailed forms. However, they are useful in cases where the measurements of the image need not correspond exactly with those of the actual object. For example, the architect uses a pictorial drawing to show his or her client how the house will look when completed.

The two principal types of pictorial drawings are perspective and axonometric drawings. A third type, the oblique drawing, is partly axonometric and partly orthographic. Because of the distorted appearance of objects drawn by the oblique method, it is not widely used for pictorial representation and will not be discussed further here.

PERSPECTIVE DRAWINGS

The type of pictorial drawing that represents an object most clearly as it is seen by the human eye is the perspective drawing. The optical line relationships in a perspective drawing are like those in a photograph; that is, all lines that are parallel on the actual object tend to converge at some distant point on the drawing.

Perspective drawings are seldom used as working drawings; they are used mainly in sales and promotion work and as architectural "presentation" drawings.

AXONOMETRIC DRAWINGS

The term "axonometric" refers to the class of pictorial drawings in which all the measurements necessary for making the drawing are made on the three principal axes of the object or on lines parallel with those axes. A rectangular solid drawing in this way consists of three sets of lines, each set being parallel to one of the principal axes, and reveals three of its faces. An infinite number of axonometric positions is possible, the choice of position depending upon how the object is to be viewed. (See Fig. F-17.) The isometric position, second from the right in the illustration, is the one most often employed. An axonometric drawing in the isometric position is called an isometric drawing.

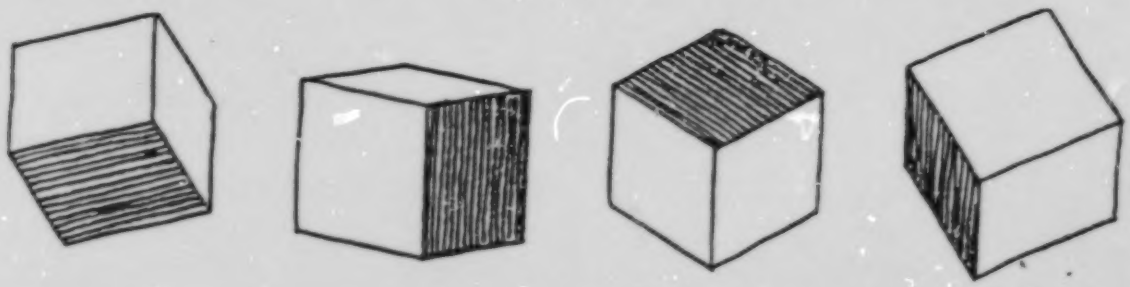


Fig. F-17. Axonometric drawings in several positions

THE THEORY OF ISOMETRIC DRAWING

The Theory of isometric drawing is that the object is viewed from the exact position in which three of its sides are seen equally foreshortened. In making an isometric drawing, the draftsperson first lays out the three isometric axes--one vertical and other two tipped up 30° from a horizontal base line, as shown in Fig. F-18. The height, width, and depth of the object are measured off on these axis lines. Since all lines on or parallel with the isometric axes are foreshortended equally, they will be in true proportion; however, they will never appear as true scale lengths, as do the lines in orthographic drawings. The relationship of an isometric view and three orthographic views of an object is shown in Fig. F-19.

ANGLES IN ISOMETRIC DRAWINGS

Angles cannot be directly transferred from orthographic drawings to isometric drawings; this is so because angles do not appear in their true shape in isometric drawings. To transfer angles in making an isometric drawing from orthographic views, the draftsperson first transfers the intersection points of the lines that form the angles, then draws the angles from the transferred points. (See Fig. F-20.)

CURVES IN ISOMETRIC DRAWINGS

Like angles, curves suffer distortion in being transferred from orthographic drawings to isometric drawings. To transfer a curve, the draftsperson first plots points on the isometric drawing from similar locations along the curve on the orthographic drawing, then connects the points with a curved line. (See Figs. F-21 and F-22.) To simplify transferring the points, he or she may lay out a grid of rectangular coordinates on the multiview drawing and a corresponding isometric grid on the sheet for the isometric drawing.

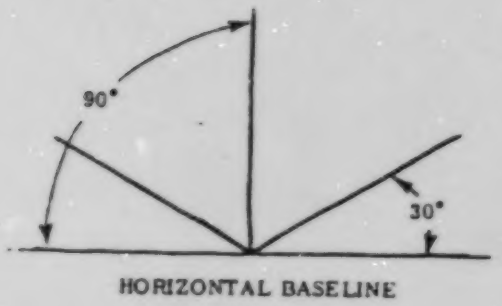


Fig. F-18. Layout of isometric axes

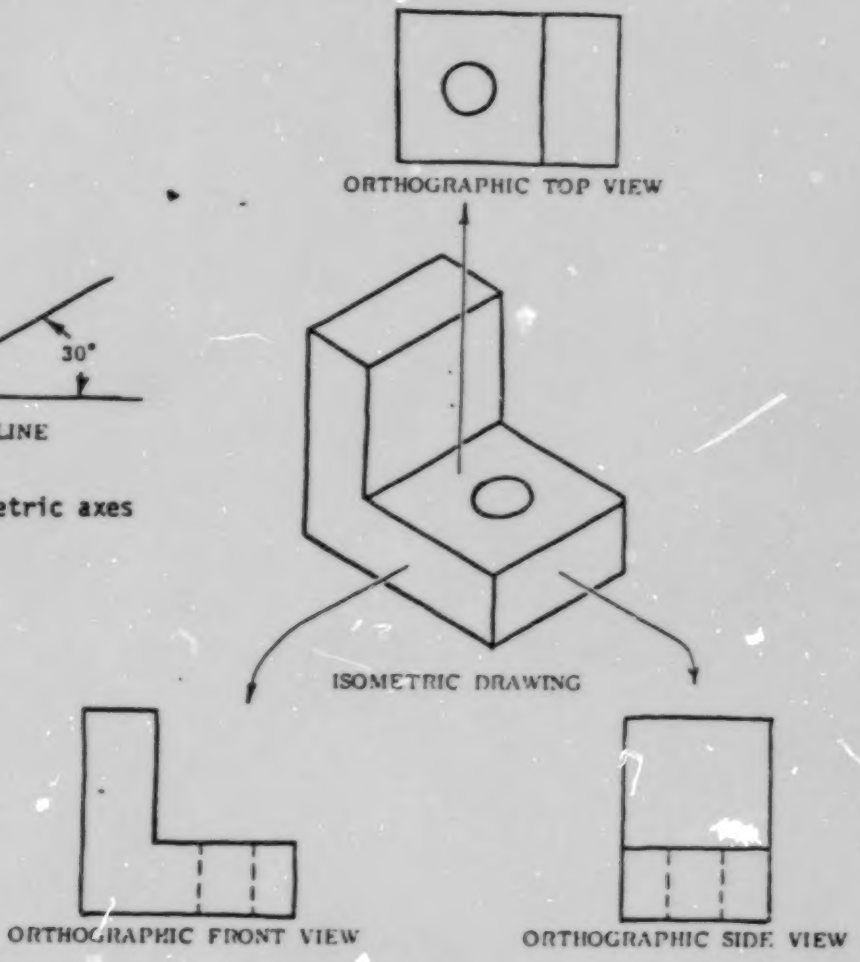


Fig. F-19
Isometric drawing and orthographic views of an object

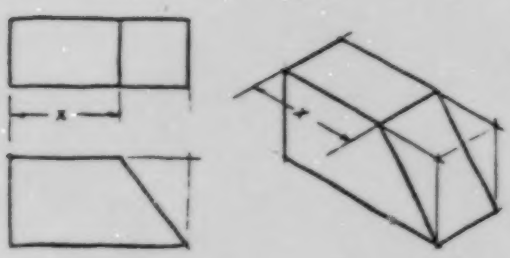


Fig. F-20
Orthographic projection and isometric drawing of an object with an angled surface

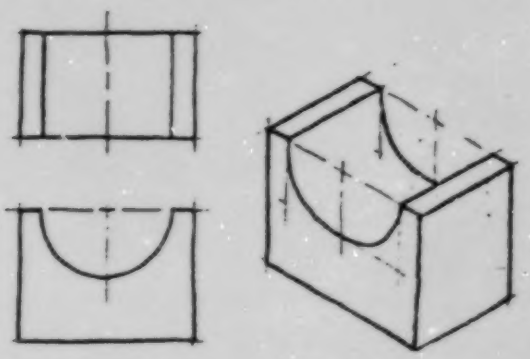


Fig. F-21
Orthographic projection and isometric drawing of an object with a curved surface

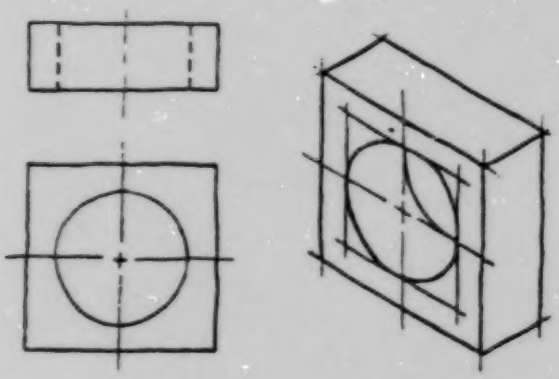
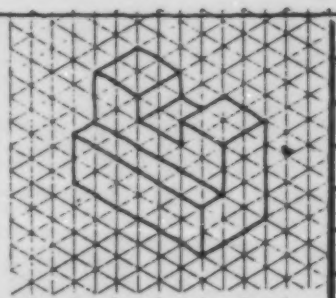


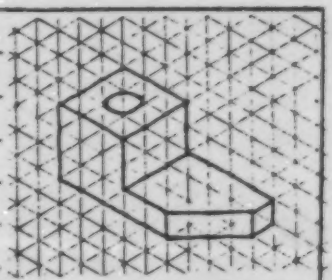
Fig. F-22

Orthographic projection and isometric drawing of an object with a center hole

Assignment

In each of the two rectangular grids on this page, sketch the top, front, and right side views of the object shown in the small isometric drawing. In each of the four isometric grids on the following page, make isometric sketches of the object shown in the small multiview drawing.





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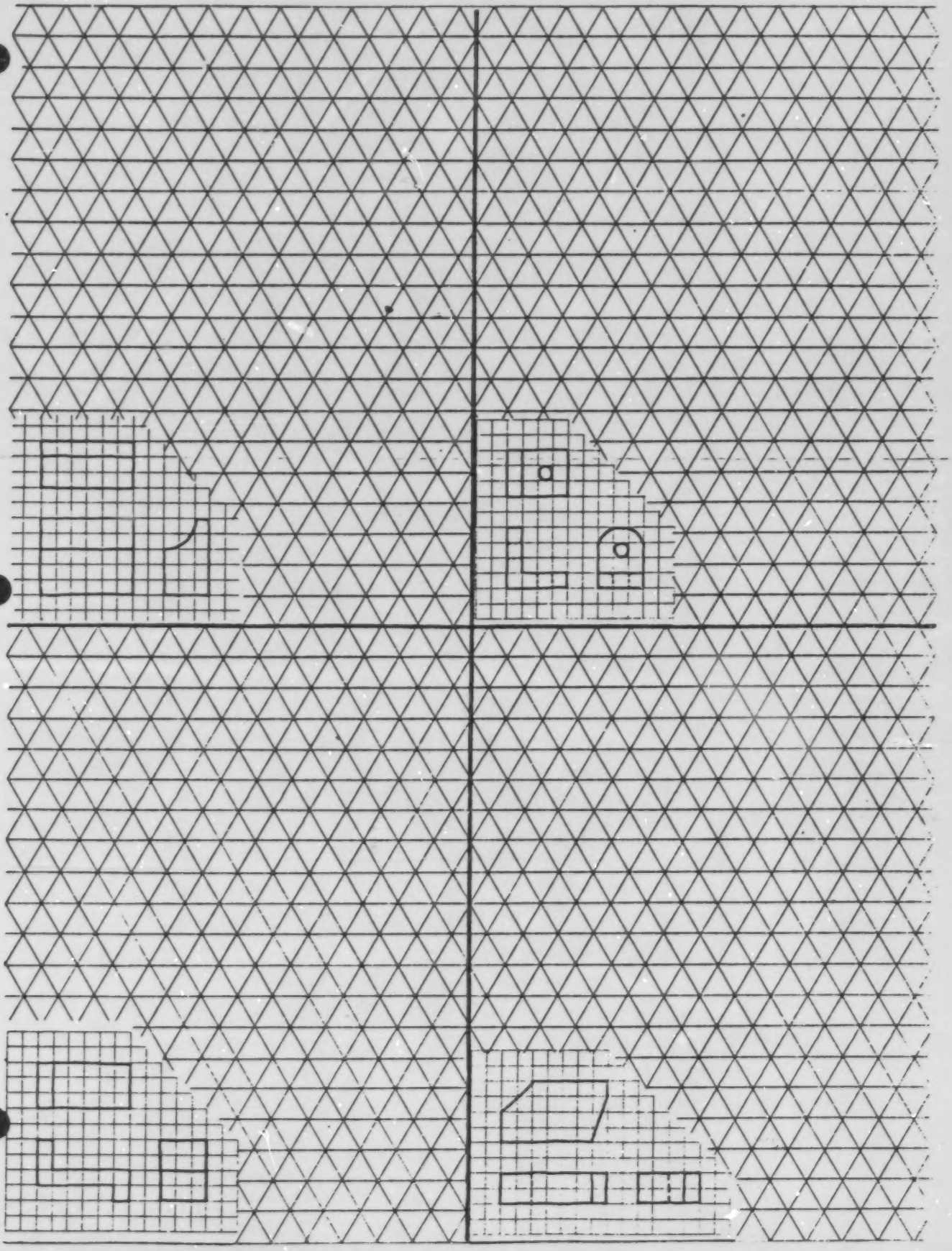
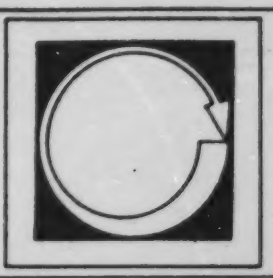


Self Assessment



After you have studied the material in the module, complete the exercises by writing in the word that belongs in each space.

1. The drawing method used for making most working drawings is called _____.

2. Orthographic drawings are drawn to _____ and _____ measurements can be taken from them.

3. An orthographic view shows only one _____ or _____ of an object.

4. In architectural drawings, a view from above is called a(n) _____ view.

5. A listing of conventional drafting lines used in the making of a working drawing is called a(n) _____ of _____.

6. The type of drawing that represents an object most nearly as it would be seen in a photograph is a(n) _____ drawing.

7. A pictorial drawing shows more than one _____ of an object.

8. The type of pictorial drawing in which all of the principal axes are equally foreshortended is the axonometric drawing.

9. In an isometric drawing, two of the three principal axes are tipped up _____ degrees from the horizontal; the third axis is _____.

SELF ASSESSMENT ANSWER SHEET

1. orthographic projection
2. scale, true
3. face, side
4. top
5. alphabet, lines
6. pictorial
7. view
8. axonometric
9. 30^{0}, 90^{0}

Post Assessment

Listed below each numbered item are four possible answers or completing phrases. Decide which of the four is correct, or most nearly correct; then write the corresponding letter in the blank space to the left of that item.

1. ____ The drawing method almost universally employed for making working drawings is called:

   a. orthographic projection
   b. isometric projection
   c. perspective drawing
   d. scaling

2. ____ One disadvantage of pictorial drawings is that in general they:

   a. are too large for use on the job
   b. are suitable only for exterior views
   c. do not accurately represent object lines and angles
   d. give a poor overall view of an object

3. ____ An isometric drawing is one kind of:

   a. orthographic drawing
   b. perspective drawing
   c. axonometric drawing
   d. multiview drawing

4. ____ An orthographic view shows how many sides or faces of an object?

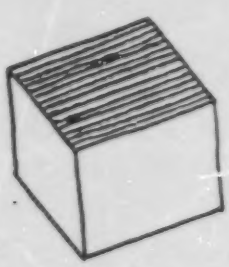
   a. one
   b. two
   c. three
   d. four

5. ____ The true shape of an object cannot be visualized from a single:

   a. orthographic view
   b. perspective view
   c. pictorial view
   d. axonometric view

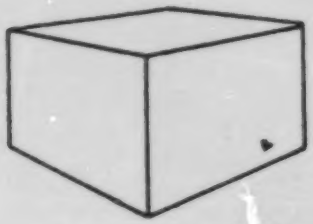
6. ____ The drawing shown below is properly called:

   a. pictorial
   b. orthographic
   c. multiview
   d. isometric



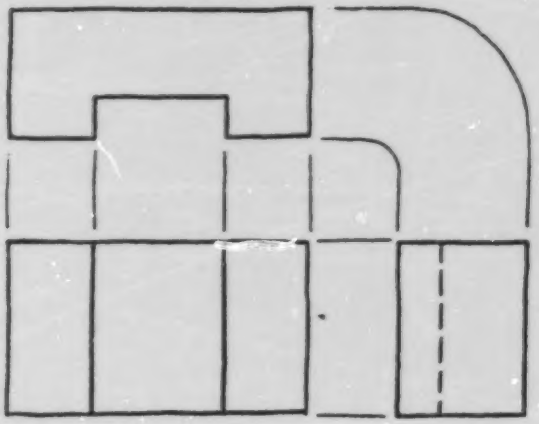
7. ____ The drawing shown below is properly called:

a. perspective
b. isometric
c. axonometric
d. orthographic



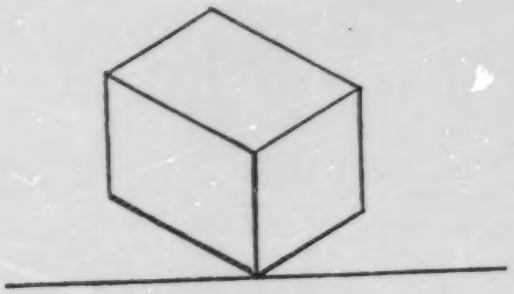
8. ____ The drawing shown below is properly called:

a. pictorial
b. perspective
c. axonometric
d. orthographic



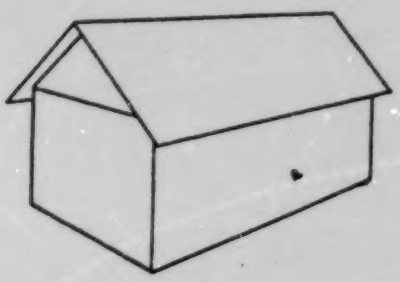
9. ____ The drawing shown below is properly called:

a. multiview
b. orthographic
c. oblique
d. isometric



10. ____ The drawing shown below is properly called:

a. pictorial
b. multiview
c. isometric
d. orthographic



3.2

BLUEPRINT READING/WORKING DRAWINGS

Goal:

The apprentice will be able to describe types of information on a working drawing.

Performance Indicators:

1. Describe site plans.
2. Describe foundation plans.
3. Describe elevations.
4. Describe detail drawings.
5. Describe shop drawings.
6. Describe notes and schedules.
7. Describe specifications.

INDIVIDUALIZED LEARNING SYSTEMS

BLUEPRINT READING
WORKING DRAWINGS

Goal:

The student will become familiar with the types of information, general and detailed, which may be found on working drawings.

Performance Indicators:

The student will refer to a set of working drawings to complete a Self Assessment and a Post Assessment exam.

Study Guide

For successful completion of this module, complete the tasks in the order listed below. Check each one off as you complete it.

1. ____ Read the Goal and Performance Indicators on the cover of this module. This will explain what you can be expected to learn from the module and how you will demonstrate it.

2. ____ Read the Introduction section and study the Information section. In these sections you will acquire the knowledge necessary to pass the Self and Post Assessment exams.

3. ____ Complete the Self Assessment exam. This will show you how well you can expect to do on the Post Assessment exam. Compare your answers with those on the Self Assessment Answer Sheet found immediately following the exam. If you scored poorly, re-study the Information section or ask your instructor for help.

4. ____ Complete the Post Assessment exam. Turn the answers in to your instructor. It is recommended you score 90% or better before continuing with the next module.

Introduction

Anyone entering any of today's trades or technical fields must have a thorough knowledge of the graphic language of blueprints. Learning this special language, like learning any other, demands careful and patient study of its theory and composition, its symbols, and its conventions. With practice, the apprentice will be able to read the new language without difficulty and employ it, through sketching, to express his or her technical ideas to others. As you acquire skill in blueprint reading, you will be able to visualize from its drawings how a technical object will look when completed and how its parts will fit together. The apprentice will also be able to determine from a study of the drawings what machines, equipment, and work processes will be needed to construct, erect, or install the object.

Working drawings--architectural or engineering drawings reproduced as blueprints--can be considered to be tools of every technical occupation. A skilled worker in any of the building trades, for example, must know how to get information from a set of working drawings quickly and accurately. To do this, the worker must be able to visualize the object from the line drawings on the blueprints. The worker must also understand the meanings of symbols and conventions, which are the "shorthand" means used by the draftsperson to indicate materials, quantities, sizes, locations, and details of construction. When necessary, the worker must be able to get from written specifications information regarding the quality of materials, finish, and workmanship agreed upon by the contractor and the client.

Information

Many present-day buildings are very complex, and the complete set of working drawings for such a building usually includes separate sheets of drawings for the several crafts--structural, plumbing, heating and ventilating, electrical, and so forth--in addition to the usual architectural drawings. Although each worker will be primarily concerned with the working drawings for his or her own trade, he or she may also need to refer to other drawings in the complete set from time to time.

A set of working drawings, reduced in size, is included at the end of this module to illustrate the discussion that follows. The apprentice should study all the drawings carefully to get a clear idea of the kinds of information each provides about the construction project (a one-room elementary school). Reading working drawings like these is part of the day-to-day work of every skilled craftsworker in the building industry.

SITE DEVELOPMENT PLAN (SHEET 1)

The first drawing to be considered in a set of blueprints for a construction project is usually the site development plan or plot plan, which may also incorporate an area map and a site grading plan. Plot plans include the following essential information that must be known before any building can be erected: compass directions, property lines, contours (slopes), location of the building or buildings on the site, and locations of roads, trees, existing structures, and utilities. Approaches to the buildings and finished grade contours are also shown.

FOUNDATION PLAN (SHEET 2)

The foundation plan for a building shows the overall dimensions of the foundation walls and includes cross sections that show the width, depth, and the height of the footings at various locations. It also indicates the placement and sizes of steel reinforcing rods and anchor bolts and the location and dimensions (including thickness) of all concrete floor slabs and steps.

FLOOR PLAN (SHEET 3)

A floor plan shows the layout of a single floor of a building. It is in effect the view from above that would be revealed if the building were sliced through horizontally at a height that would best show interior features. The floor plan shows the arrangement, size, and shape of the rooms; the thickness of walls and partitions; the location of windows, doors, and other wall openings; and the size, shape, and location of plumbing fixtures and other mechanical fixtures.

Symbols are employed to represent mechanical features and details where this results in the simplification or clarification of the floor plan. The apprentice should give careful attention to the various uses made of symbols not only on the floor plan but on all the other working drawings of this set as well. If the meaning of a symbol, a term, or an abbreviation on the drawing is not clear, he or she should ask the instructor to explain it.

EXTERIOR ELEVATIONS (SHEET 3)

An exterior elevation is a view of one side or the front or back of a structure, showing its shape, the size and location of openings, and other features as roof details and exterior finishes.

INTERIOR AND SECTIONAL ELEVATIONS (SHEETS 5 AND 6)

Interior elevations show the placement and relationship of interior parts of the building. Sectional elevations are detailed interior elevations that represent the building, or some part of it, as if it were sliced through vertically. Many interior and sectional drawings may be needed to provide all the essential information about such items as wall construction, joinery, and interior openings in a complex structure.

DETAIL DRAWINGS (SHEETS 4 AND 7)

When a construction detail is shown with insufficient clarity or completeness in a floor plan, elevation, or other small-scale drawing, the detail is presented elsewhere drawn to a larger scale. The detail drawing is keyed to the smaller-scale drawing by means by an identifying number or letter.

SHOP DRAWINGS

Shop drawings are an exception to the general rule that the architect or engineer

shall provide all the working drawings needed for bringing the construction project to completion. (No examples of shop drawings are included in this module.) A shop drawing is a blueprint that may be supplied by a manufacturer of special equipment--commercial cabinets and fixtures, for example--to show how the equipment is constructed and how it should be installed. Shop drawings must have the approval of the architect or engineer.

NOTES AND SCHEDULES (SHEETS 3 and 4)

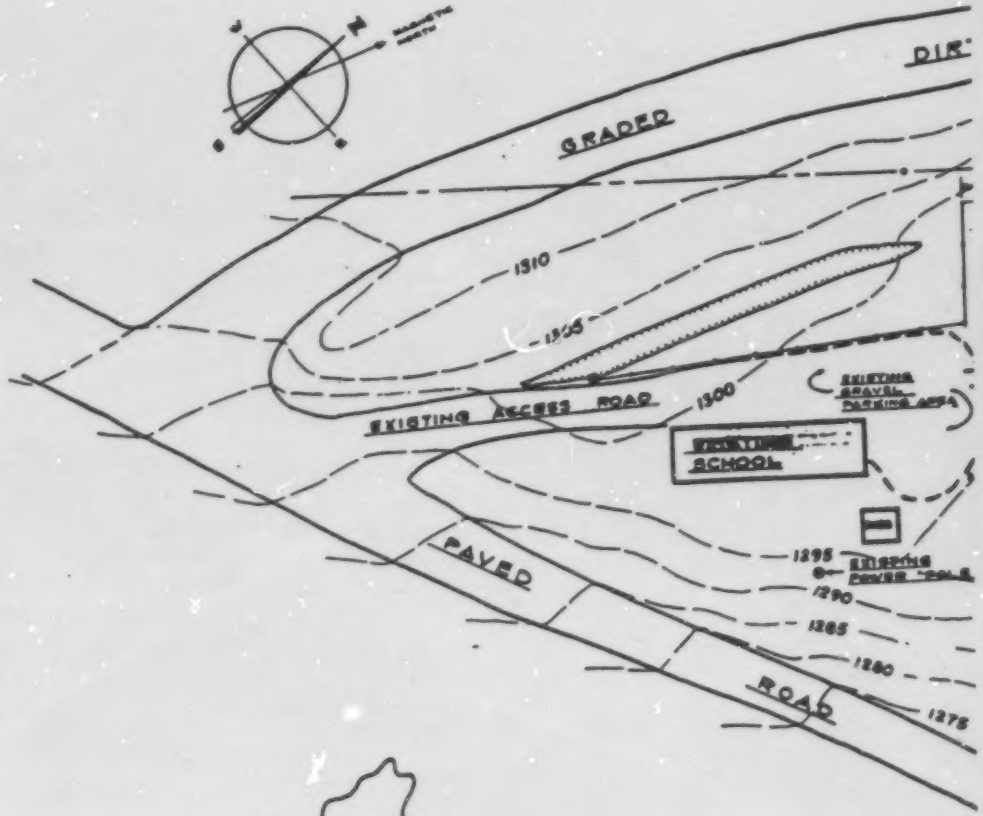
The working drawings that make up a complete set are interrelated, and they must be read together if they are to be used effectively. Information given on one drawing often clarifies information given on another, and a separate set of written specifications backs up the drawings. Also, most working drawings contain brief notes referring to other drawings or to information in the specifications that cannot well be shown by a symbol. In addition, many working drawings also include schedules--charts or tables containing data on doors, windows, special equipment, and the like.

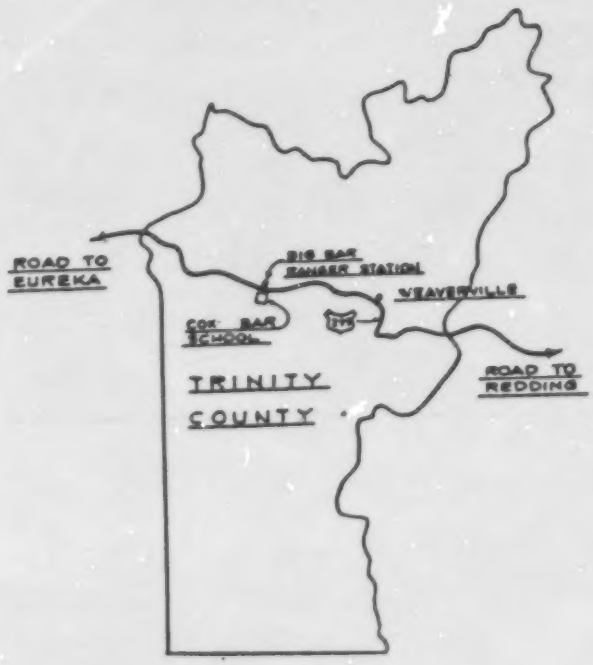
SPECIFICATIONS AND THE CONTRACT

The written specifications that accompany a set of working drawings present all the information about the construction project that cannot be shown conveniently on the drawings. They give a detailed account of the quality of workmanship and materials that apply in every phase of the project, spell out the responsibilities of the contractor, the subcontractors, and the owners.

Drawings and specifications should agree in all details, but if they are found to be in conflict in any way, the specifications are to be followed.

WORKING DRAWINGS





AREA MAP - NO SCALE

GENERAL NO

1. CLEAR AND GRAD
AND ASPHALT
2. PROVIDE PAD
3. PAVE HAROCOU
AND TETHERBAL
4. FINISH GRADE

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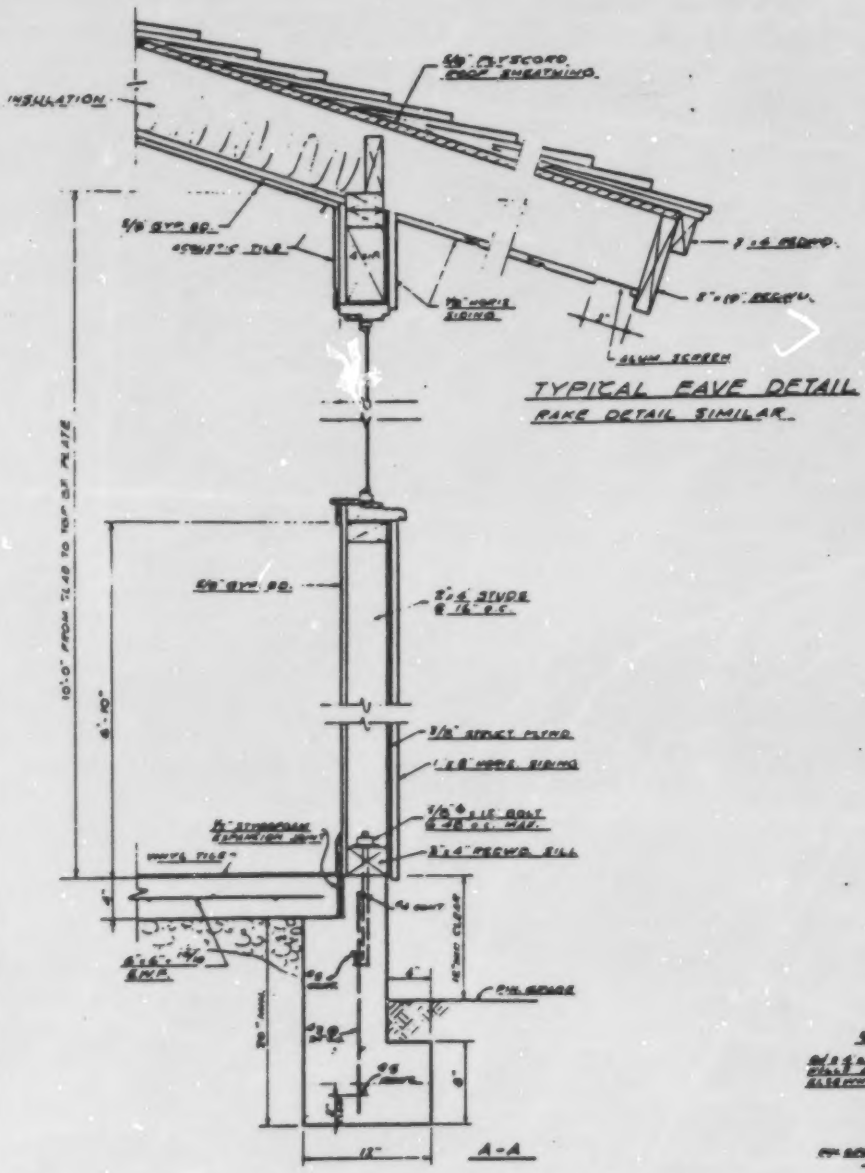

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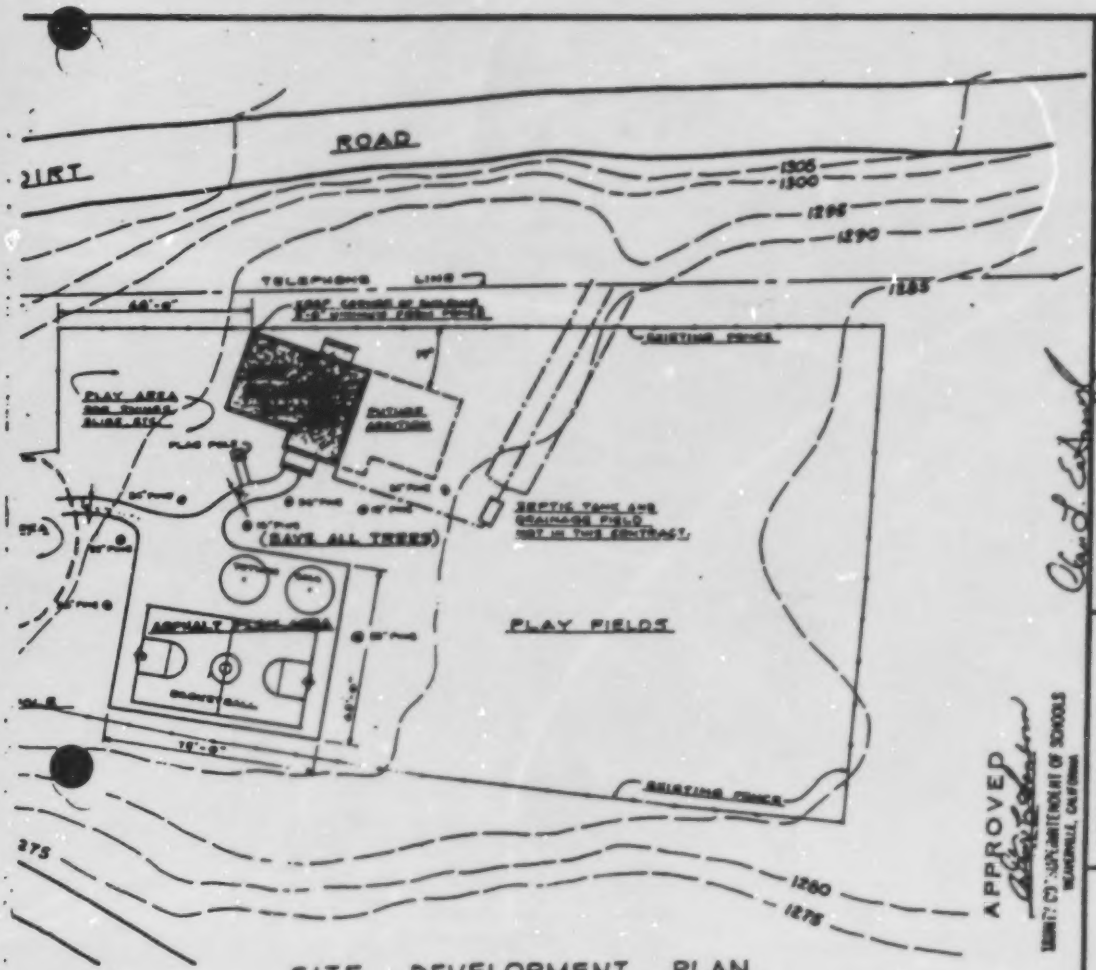

SITE DEVELOPMENT PLAN

SCALE 1" = 80'-0"

APPROVED

BOARD OF TRUSTEES OF SCHOOLS
MARYSVILLE, CALIFORNIA

APPROVALS

CALIF. STATE DEPT. OF EDUCATION
BUREAU OF SCHOOL PLANNING
721 CAPITOL AVENUE
SACRAMENTO 14, CALIF.

C. L. BATOUGH, ARCHITECT

DATE: FEBRUARY, 1963

THIS PLAN IS NOT TO BE USED UNTIL LEGAL REQUIREMENTS ARE SET AND AUTHORIZATION TO PROCEED WITH CONSTRUCTION HAS BEEN GIVEN BY THE STATE DIVISION OF ARCHITECTURE.

SITE DEVELOPMENT PLAN

COX BAR ELEMENTARY SCHOOL

1

NOTES: CONTRACTOR SHALL —

- GRADE SITE ONLY AS REQUIRED TO CONSTRUCT NEW SCHOOL, WALKS & PLAY AREA.
- FOR NEW SCHOOL AND POSSIBLE FUTURE ADDITION.
- COURT PLAY AREA AND WALKS AS SHOWN. INSTALL BASKETBALL BALL STANDARDS.
- ALL AREA WITHIN 40 FEET OF NEW SCHOOL.

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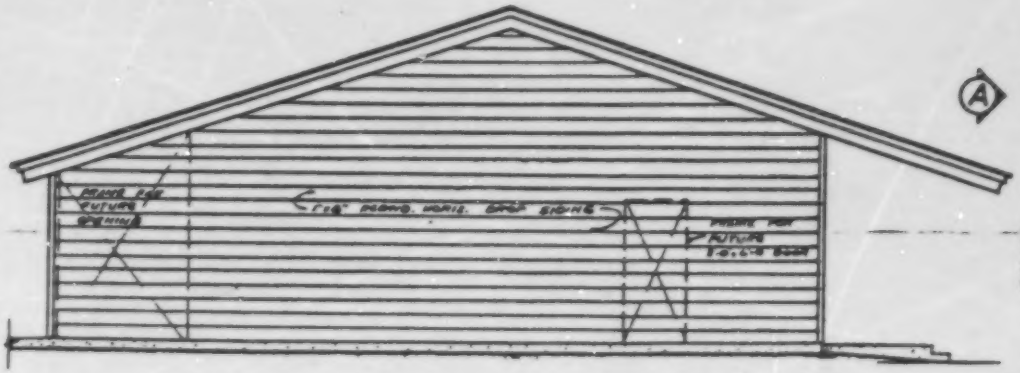
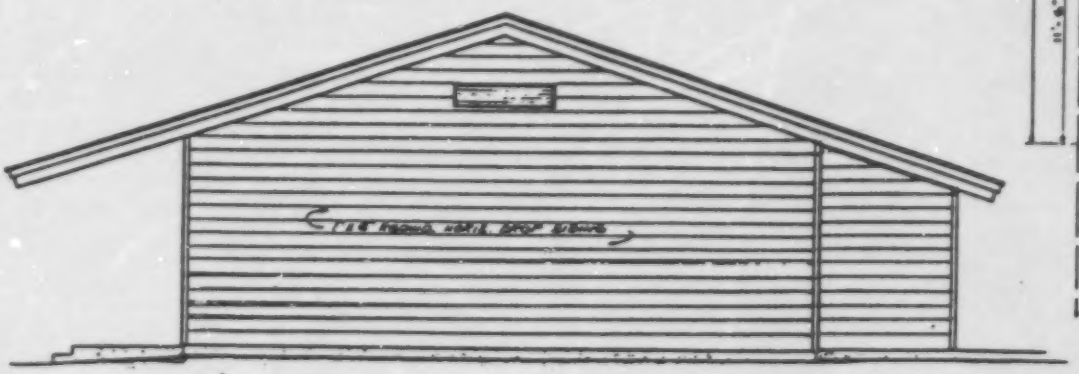
SPECIAL EQUIPMENT SCHEDULE

NOTE: THESE ITEMS ARE NOT IN THE CONSTRUCTION CONTRACT. THE SCHOOL DISTRICT MAY PURCHASE ITEMS DIRECT FROM SUPPLIER.

ITEM	SYMBOL	SIZE	MANUFACTURER & REMARKS
RANGE		HT. 36", WIDTH 30", DEPTH 30"	HOTPOINT MODEL HAB 200
REFRIGERATOR		HT. 73⅞", WIDTH 33", DEPTH 31"	PUFFER HUBBARD MODEL 31-2TC
FOLDING STAGE		OPEN 8'-0" WIDE, 7'-9" DEEP, CLOSED 1'-6½" DEEP	GRUNSWICK
MOVABLE STOR. COUNTER		24" x 48" x 30"	EDUCATORS #403
MOVABLE SINGLE SINK UNIT		24" x 48" x 30"	EDUCATORS #407
PAPER STORAGE		36" x 48" x 84"	EDUCATORS #409
PORTA-BENCH		36" x 48" x 32"	EDUCATORS #421



ELEVATION (A)



ELEVATION (C)

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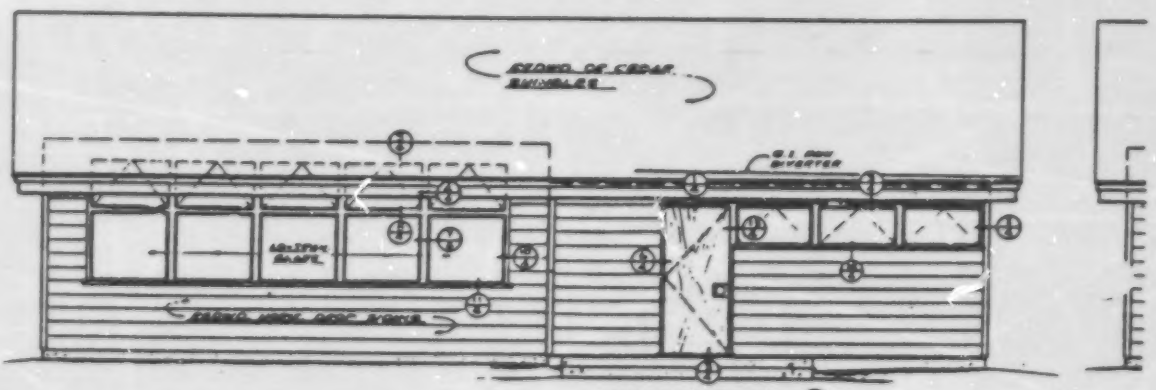
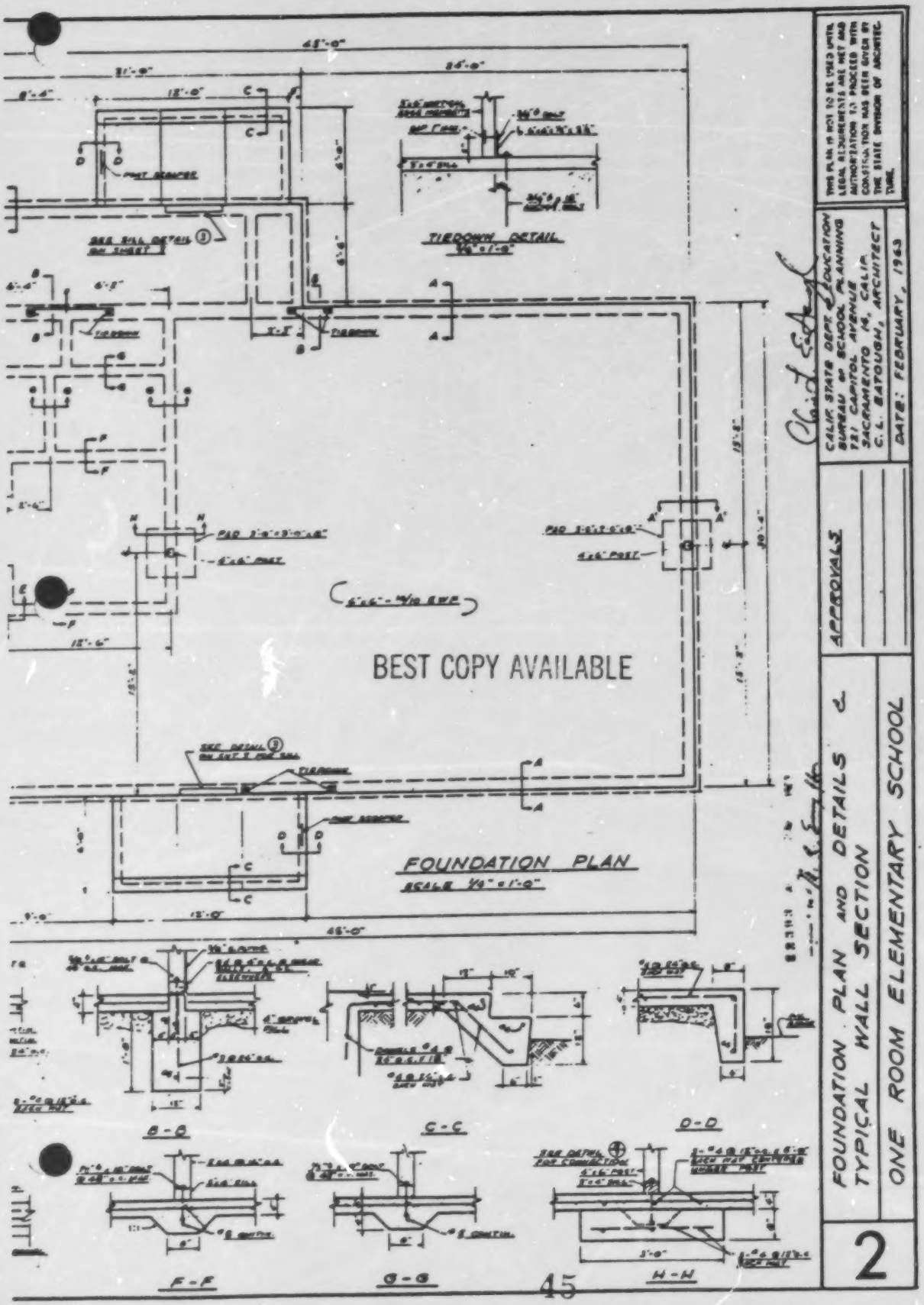


ELEVATION (B)



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721 CAPITOL AVENUE
SACRAMENTO 14, CALIF.
C. L. BATOUGH, ARCHITECT

DATE: FEBRUARY, 1963

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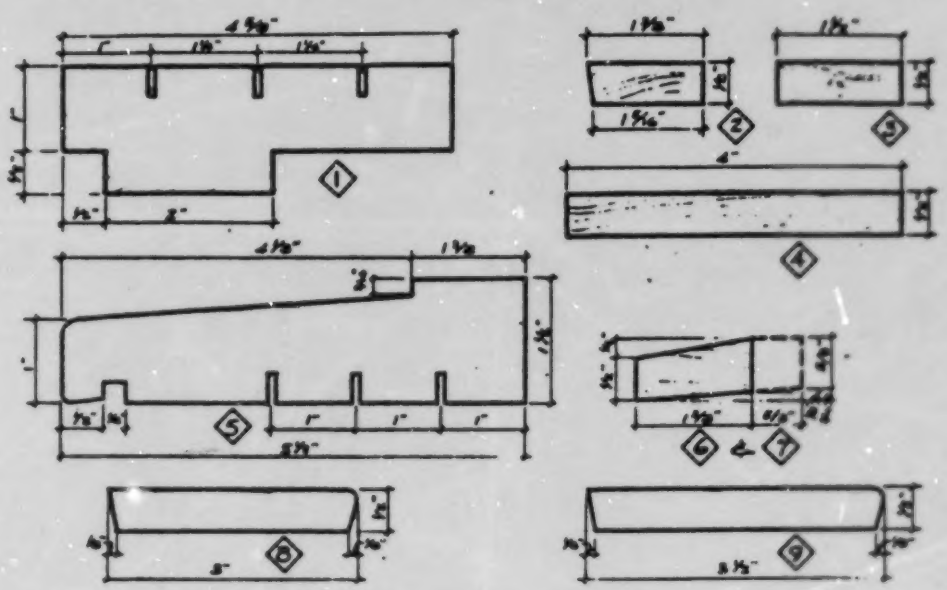
FOUNDATION PLAN AND DETAILS &
TYPICAL WALL SECTION

ONE ROOM ELEMENTARY SCHOOL

2



MILLWORK SECTIONS — FULL SIZE

MILLWORK SPECIFICATIONS

EXTERIOR MATERIAL — SHALL BE CLEAR, KILN-DRIED PONDEROSA PINE, TREATED WITH WATER-REPELLENT PRESERVATIVE, OR SHALL BE No 1, CLEAR, KILN-DRIED REDWOOD. ALL MILLWORK SHALL BE PRIMED ALL SIDES WITH WHITE LEAD PRIMER. GALVANIZED NAILS TO BE USED ON ALL EXTERIOR WORK.
INTERIOR MATERIAL — MAY BE No 1 CLEAR, KILN-DRIED DOUGLAS FIR. ALL MILLWORK SHALL CONFORM TO THE STANDARDS OF THE WOODWORK INSTITUTE OF CALIFORNIA.

DOOR SCHEDULE

SYMBOL	DOOR SIZE	DOOR TYPE	DOOR MATERIAL	DOOR REMARKS	HARDWARE BUTTS	HARDWARE SIZE	HARDWARE LOCK SETS	HARDWARE CLOSER	HARDWARE KICKPLATE	HARDWARE THRESHOLD
(A)	3'-6" x 7'-0"	FLUSH SCREEN DOOR, SOLID CORE	BIRCH PLYWOOD	WEATHERSTRIP	1½ PR. @	4½" x 4½"	No 955	'CORBIN' SIZE 4	1 PER DOOR	@ SILL
(B)	2'-6" x 6'-8"	FLUSH DOOR, SOLID CORE	"	"	——	1½ PR. @	4" x 4"	No 918	'CORBIN' SIZE 3	1 PER DOOR	——
(C)	1'-10" x 6'-8"	BUILT-UP FRAME	"	"	——	1 PR @	3½" x 3½"	No 956	——	——	——
(D)	2'-8" x 6'-8"	SOLID CORE	"	"	——	1½ PR. @	3½" x 3½"	No 940	——	1 PER DOOR	——
(E)	3'-0" x 6'-8"	SOLID CORE	"	"	SLIDING TYPE	NOT REQUIRED	——	——	——	——	——

DOOR & HARDWARE SPECIFICATIONS

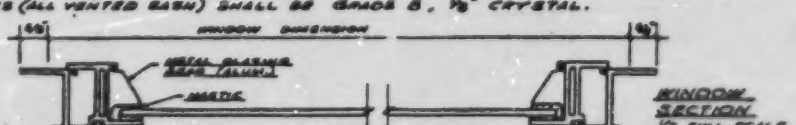
1. EXTERIOR DOORS TO BE PRE-FINISHED 'WELDWOOD' 'STAY-SMART' DOORS, 1¾" THICK
2. LOCKSETS TO BE 'CORBIN' (SEE SCHEDULE) 'SPARTAN' DESIGN SERIES. INTERIOR DOORS ARE 1⅜".
3. DOOR CLOSERS TO BE 'CORBIN' (SEE SCHEDULE).
4. EXTERIOR BUTTS SHALL HAVE BALL BEARING UNITS WITH NON-REMOVABLE PINS, SANDBLASTED AND PRIME COATED. USE 'STANLEY' OR EQUAL.
5. INTERIOR BUTTS TO BE DULL CHROME WITHOUT BALL BEARINGS.
6. TRACK FOR SLIDING DOORS SHALL BE 'GRANT' - 0 1100 WITH NYLON ROLLERS. USE 'GRANT' ALUMINUM FLUSH RECTANGULAR PULLS
7. THRESHOLDS FOR EXTERIOR DOORS SHALL BE 'ACCURATE' ALUM. SILLS (SEE SCHEDULE).
8. KICKPLATES TO BE 14-GA., U.S.-28, SIZE 12" HIGH BY 1/2" LESS THAN DOOR WIDTH. BEVEL ALL SIDES. INSTALL ON PUSH SIDE OF DOORS.
9. FINISH — ALL HARDWARE SHALL BE U.S. STANDARD 26 D UNLESS OTHERWISE INDICATED.
10. CONTRACTOR SHALL FURNISH AND INSTALL HARDWARE AS REQUIRED.

WINDOW SCHEDULE

SYMBOL	WINDOW SIZE	WINDOW TYPE	WINDOW GLAZING	WINDOW MANUFACTURER	WINDOW REMARKS	HARDWARE CATCH	HARDWARE SCREENS
(A)	3'-6"w x 5'-9"h	ALUMINUM	CLEAR	'SOULE' SERIES 900	PROJECT IN, TOP HINGED	No 9P-18	——
(B)	——	FIXED	LOW TRANS.	——	SET IN WOOD STOPS	——	——
(C)	——	FIXED	NONE	——	SCREEN IN WOOD FRAME		ALUM. SCREEN

WINDOW & GLAZING SPECIFICATIONS

1. WINDOWS SHALL BE 'SOULE' SERIES 900 ALUMINUM WINDOWS OR APPROVED EQUALS. CONTRACTOR SHALL ORDER WINDOWS TO DIMENSIONS SHOWN ON THE SCHEDULE AND SHALL NOTE THAT WINDOWS ARE VENTED TO PROJECT INWARD AND HINGED AT THE TOP.
2. ALL GLAZING OF ALUM. SASH SHALL USE SNAP-IN METAL BEADS. ALL GLASS SHALL SIT IN A MASTIC BED. MAKE WATER-TIGHT. (SEE ½ FULL SIZE DETAIL, THIS SHEET).
3. LIGHT REDUCING GLASS (ALL FIXED SASH) SHALL BE FIRST QUALITY AS MANUFACTURED BY PITTSBURG GLASS CO. USE GRAYLITE No 14 GLASS. ALL GLASS SHALL BE SET WITH THE WAVE RUNNING HORIZONTALLY.
4. CLEAR GLASS (ALL VENTED SASH) SHALL BE GRADE B, ⅛" CRYSTAL.



WINDOW SECTION ½ FULL SCALE

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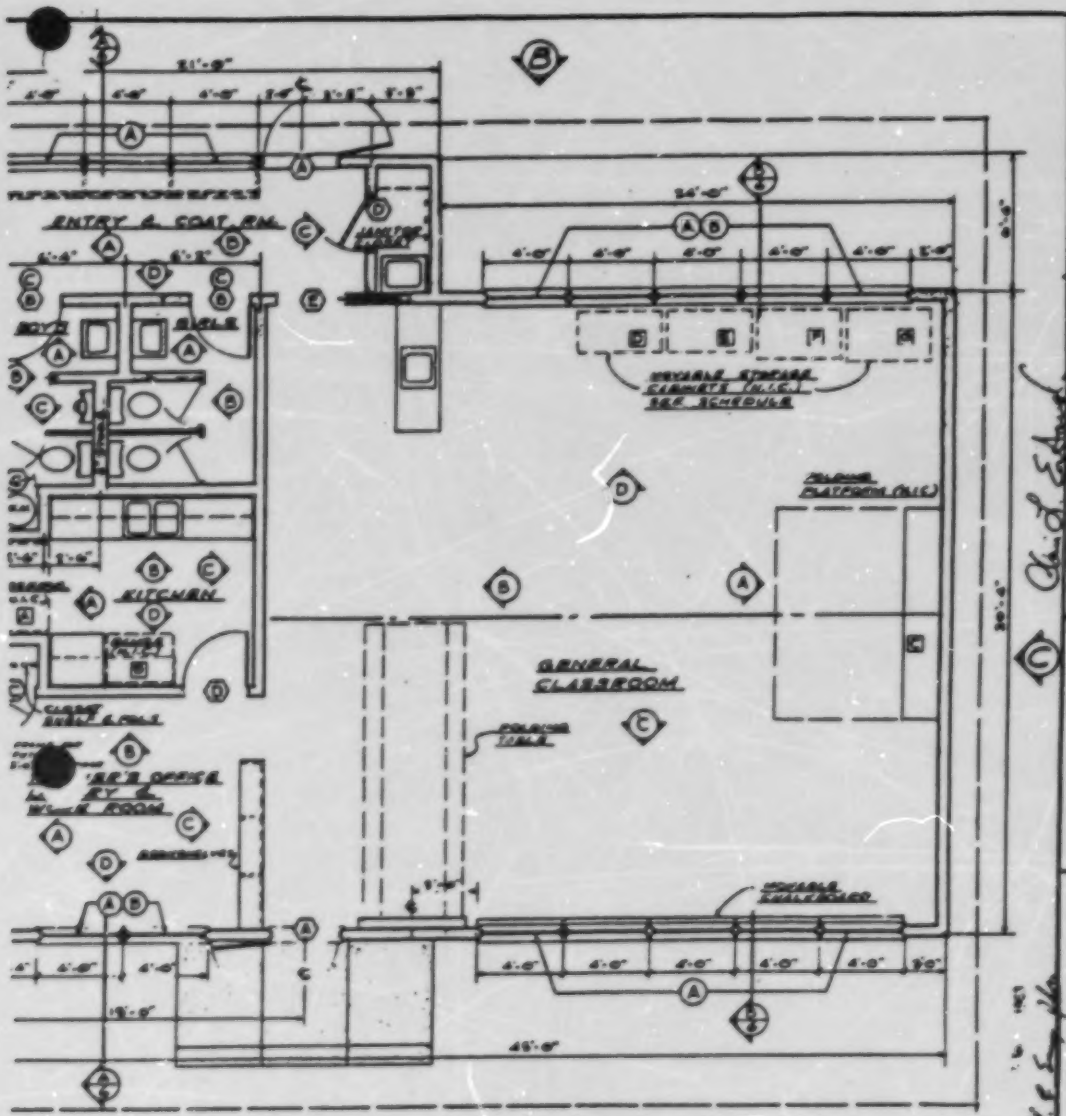

FLOOR PLAN SCALE 1/4"=1'-0"

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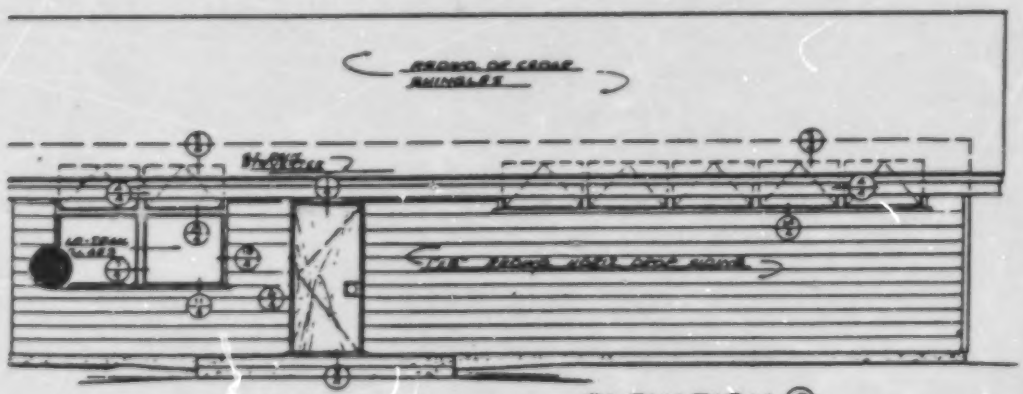

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SACRAMENTO 14, CALIF.
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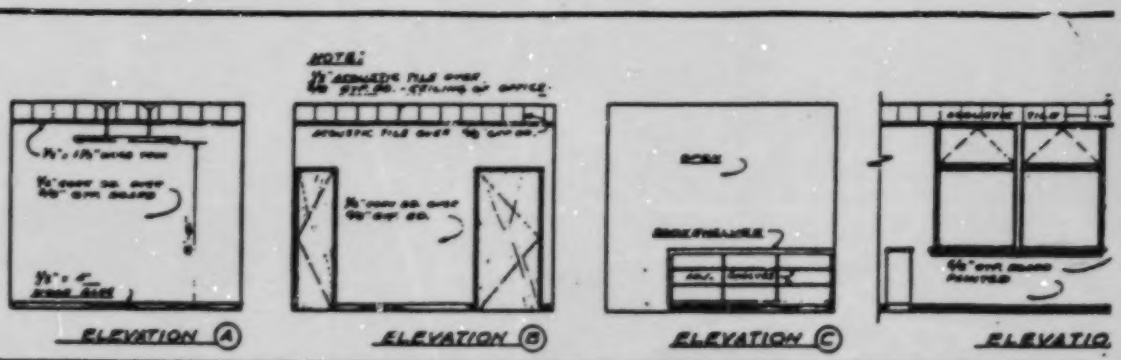
DATE: FEBRUARY, 1963

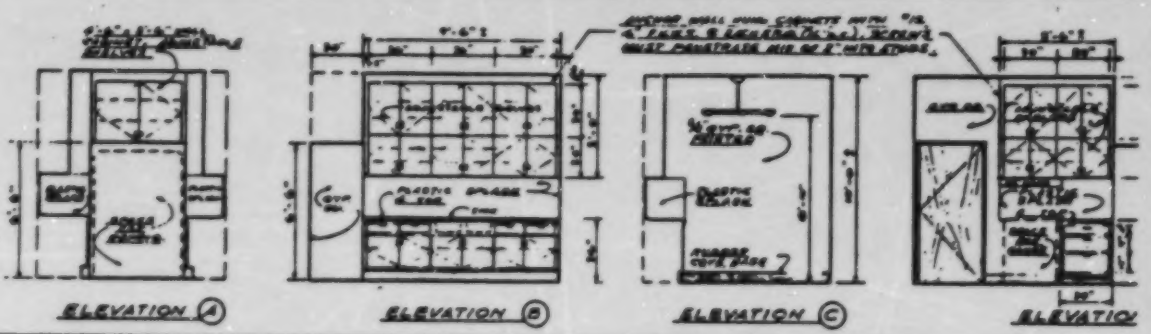
FLOOR PLAN & EXTERIOR ELEVATIONS

ONE ROOM ELEMENTARY SCHOOL

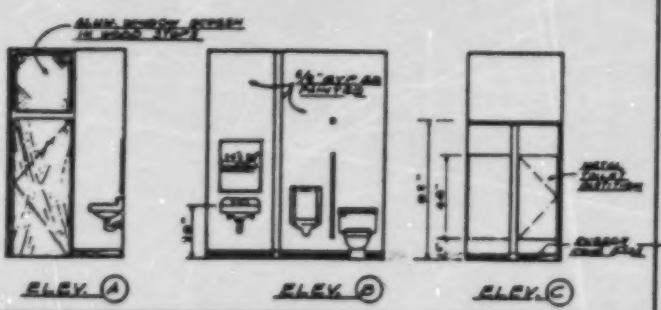
3



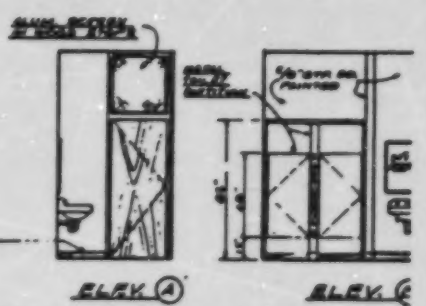
OFFICE - WORKROOM AREA



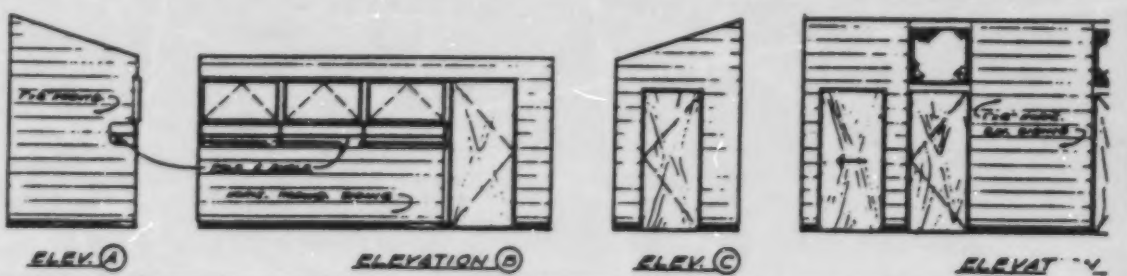
KITCHEN



BOYS' TOILET RM.



GIRLS' TOILET



ENTRY & COAT ROOM

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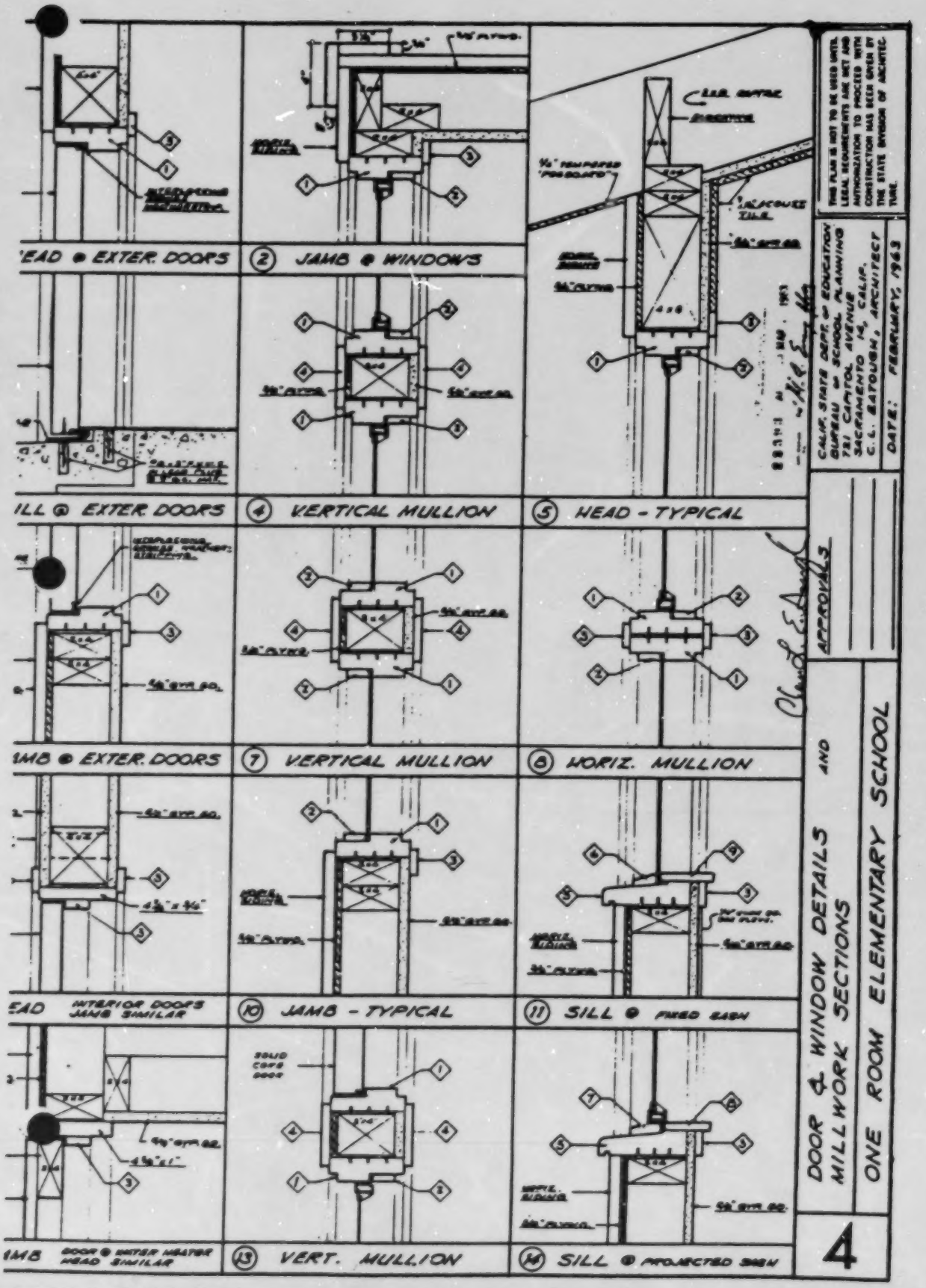
HEAD @ EXTER. DOORS
(2) JAMB @ WINDOWS
SILL @ EXTER. DOORS
(4) VERTICAL MULLION
(5) HEAD - TYPICAL
JAMB @ EXTER. DOORS
(7) VERTICAL MULLION
(8) HORIZ. MULLION
HEAD INTERIOR DOORS JAMB SIMILAR
(10) JAMB - TYPICAL
(11) SILL @ FIXED SASH
JAMB DOOR @ WATER HEATER HEAD SIMILAR
(13) VERT. MULLION
(14) SILL @ PROJECTED SASH
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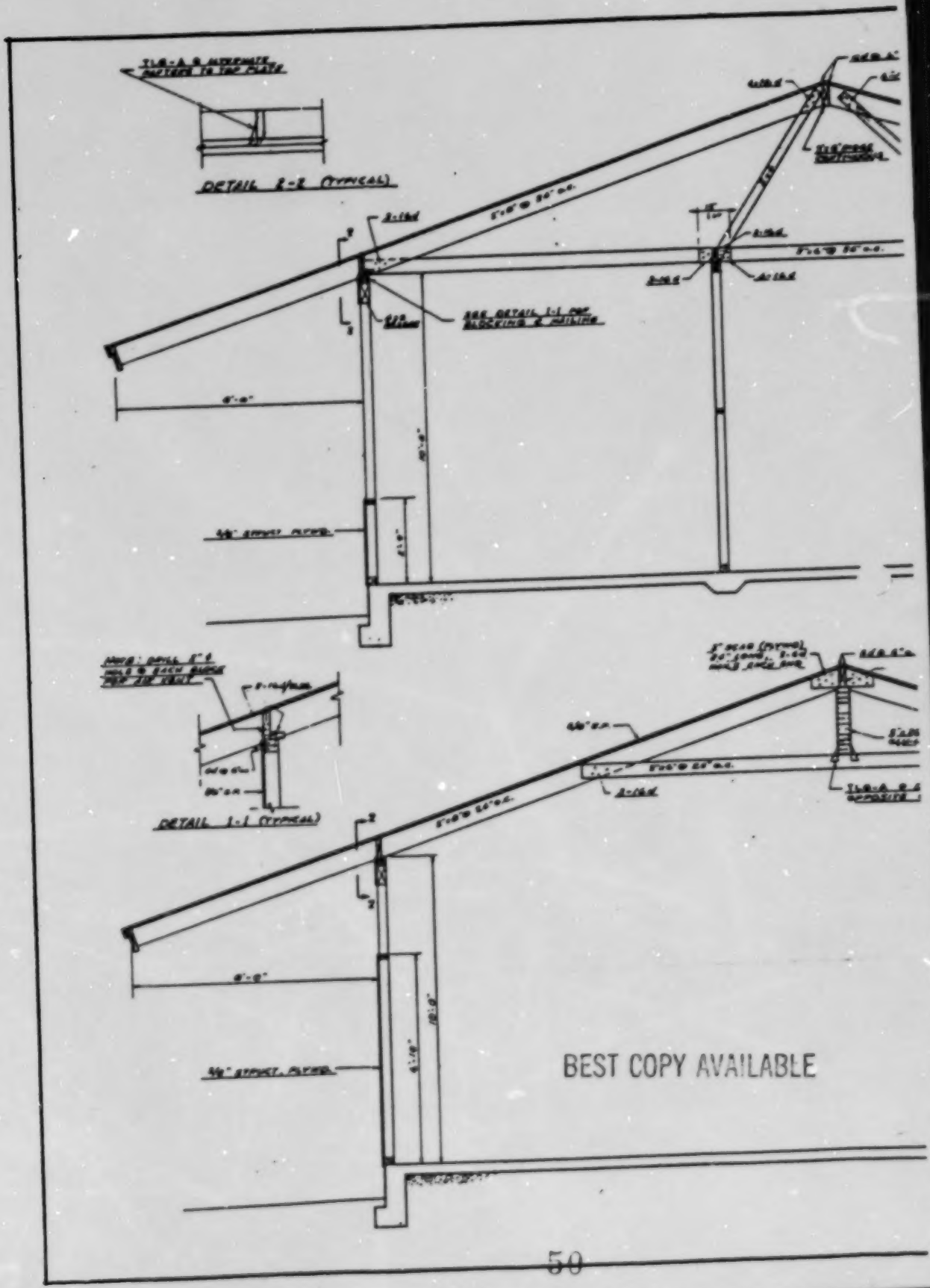
CALIF. STATE DEPT. OF EDUCATION
BUREAU OF SCHOOL PLANNING
721 CAPITOL AVENUE
SACRAMENTO 14, CALIF.
C. L. BATOUBIN, ARCHITECT
DATE: FEBRUARY, 1963
APPROVALS
DOOR & WINDOW DETAILS AND MILLWORK SECTIONS
ONE ROOM ELEMENTARY SCHOOL
4



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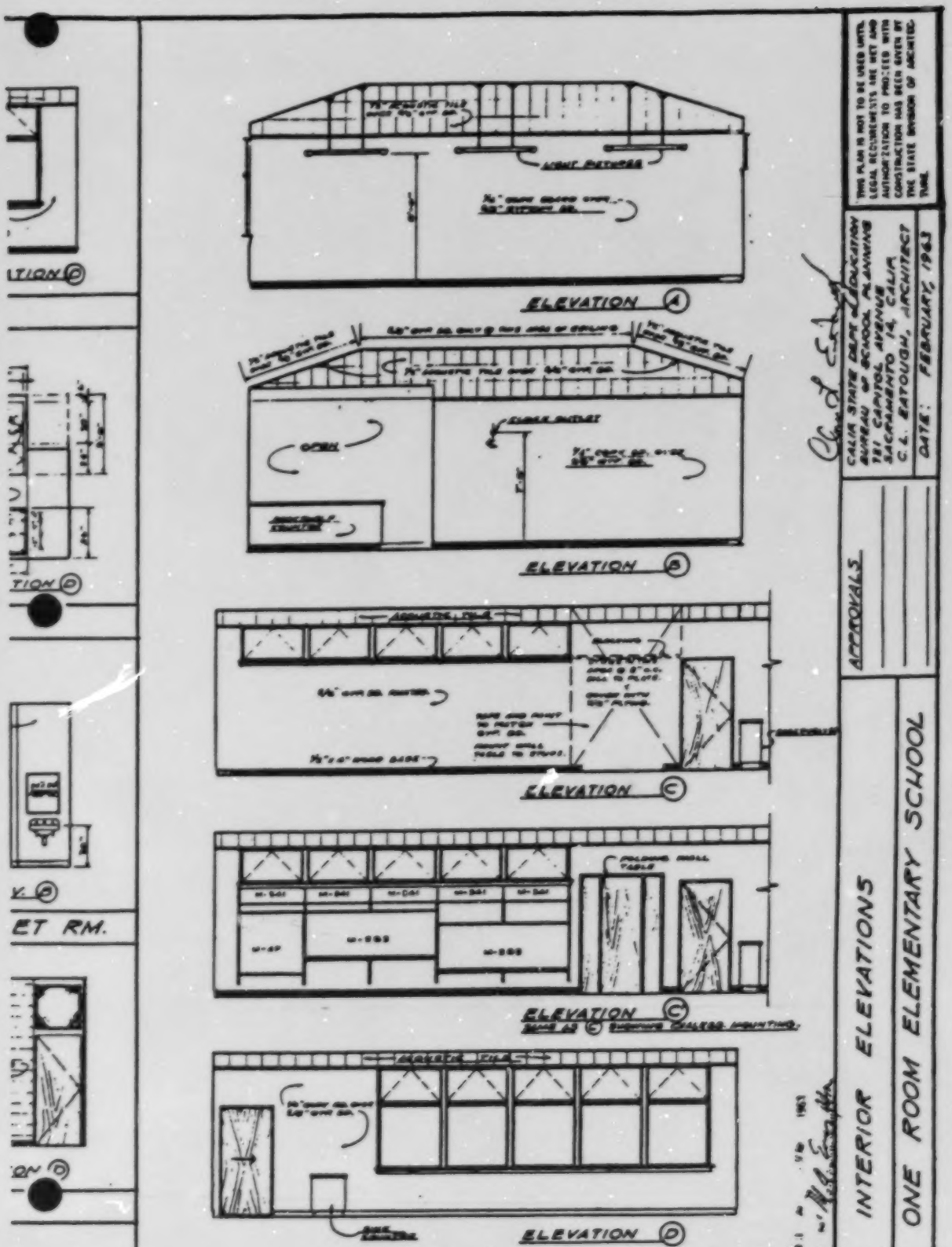

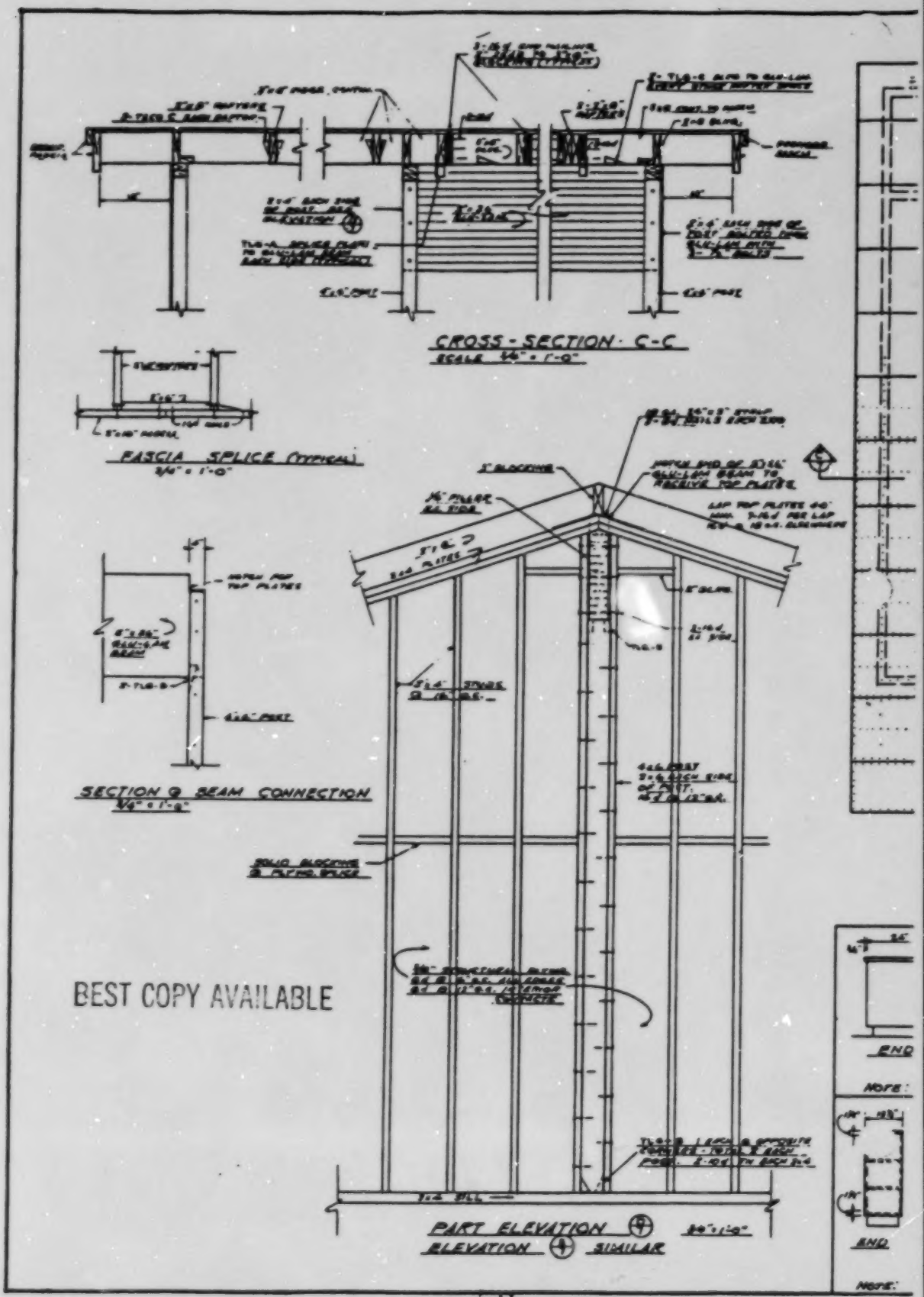

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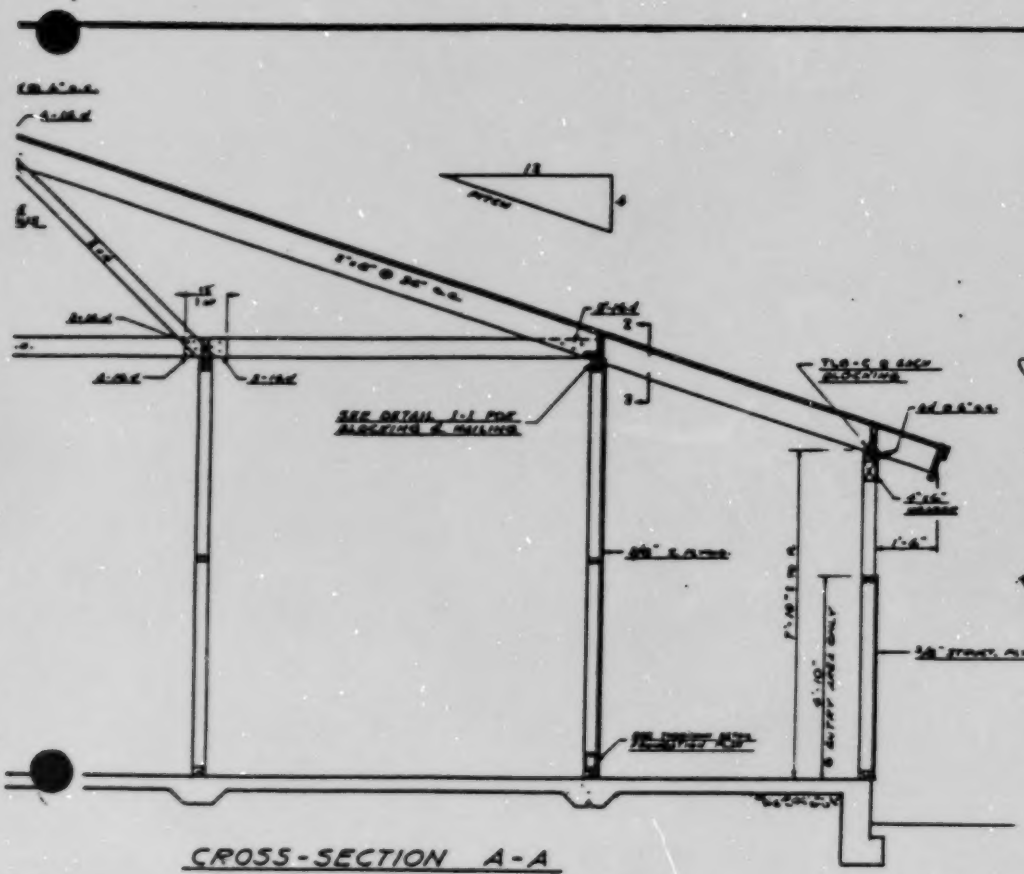
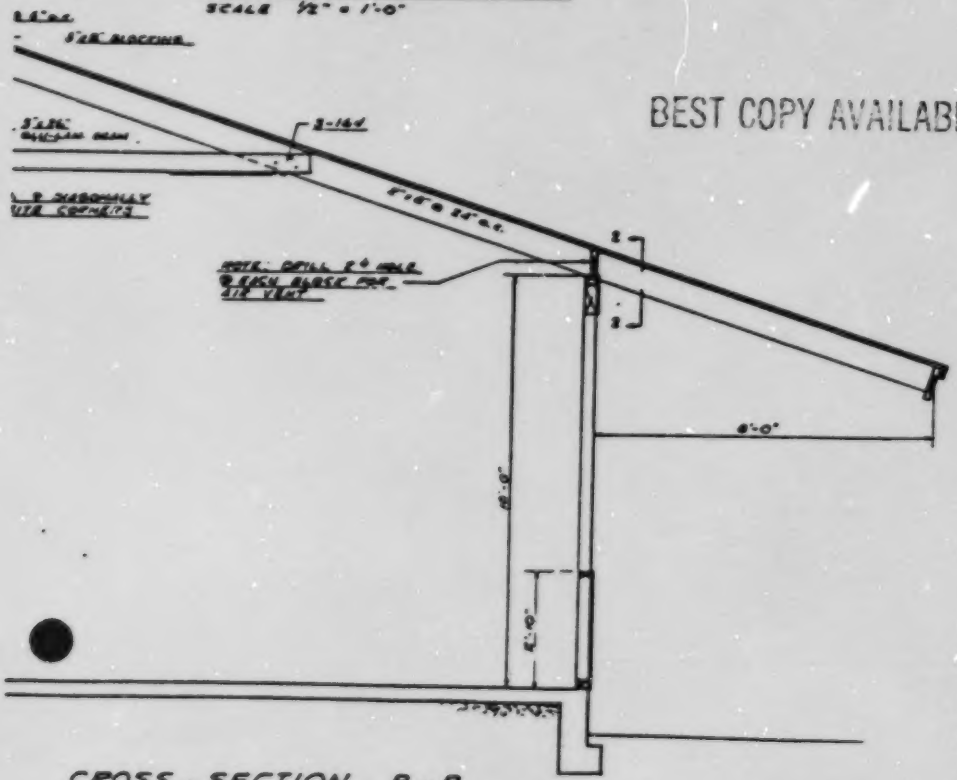


CROSS-SECTION A-A
SCALE ½" = 1'-0"



CROSS-SECTION B-B
SCALE ½" = 1'-0"

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C.L. BATCHELOR, ARCHITECT

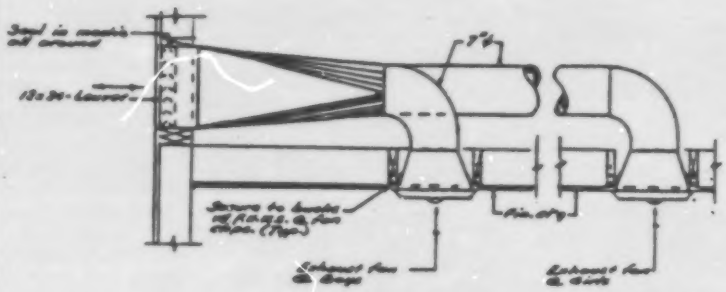
DATE: FEBRUARY, 1963

APPROVALS

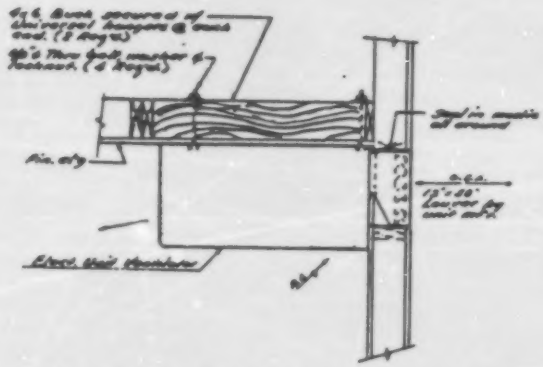
STRUCTURAL FRAMING SECTIONS

ONE ROOM ELEMENTARY SCHOOL

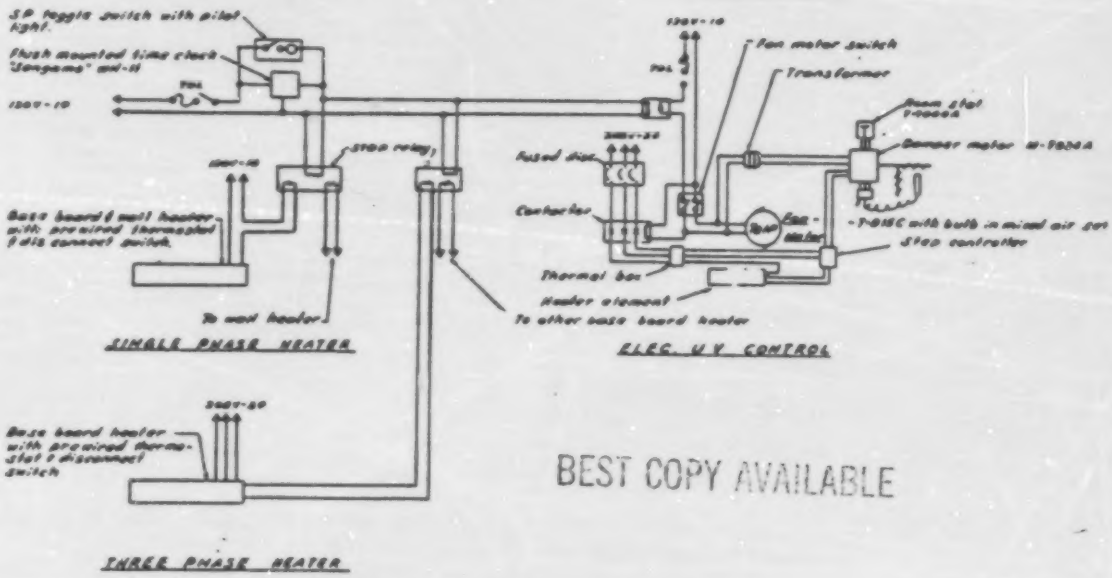
6



TOILET EXHAUST DETAIL SCALE 1"=1'-0" (A)



ELECTRIC UNIT VENTILATOR MOUNTING DETAIL SCALE 1"=1'-0" (B)



CONTROL DIAGRAM (C)
NO SCALE

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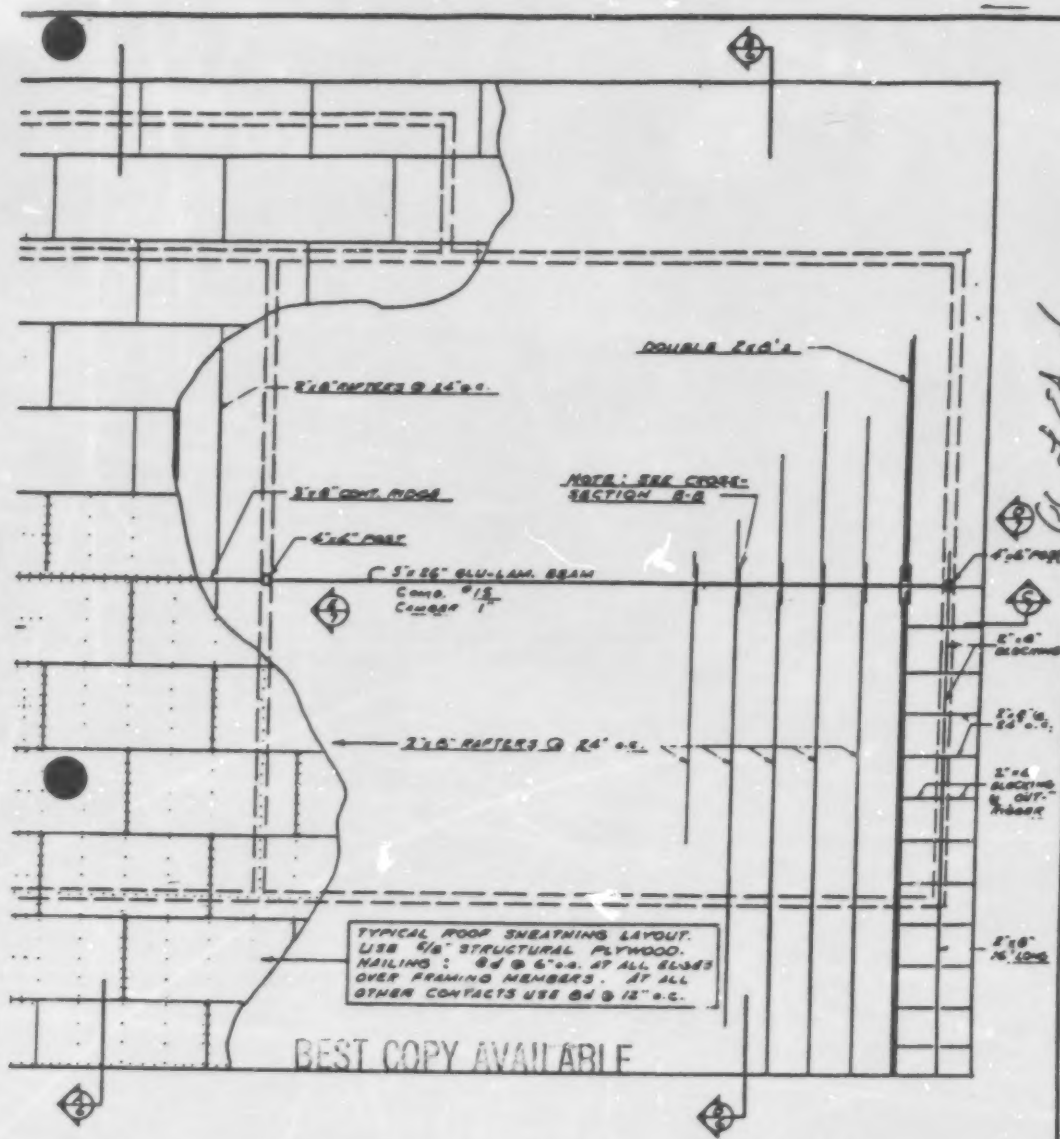
DOUBLE 2x8's
2"x8" RAFTERS @ 24" o.c.
2"x8" CONT. RIDGE
4"x6" POST
NOTE: SEE CROSS-SECTION B-B
5"x22" GLU-LAM. BEAM
Camb. 0/15
Camber 1"
2"x6" BLOCKING
2"x6" RAFTERS @ 24" o.c.
2"x6" BLOCKING @ OUTRIGGER
TYPICAL ROOF SHEATHING LAYOUT.
USE 5/8" STRUCTURAL PLYWOOD.
NAILING: 8d @ 6" o.c. AT ALL EDGES OVER FRAMING MEMBERS. AT ALL OTHER CONTACTS USE 8d @ 12" o.c.
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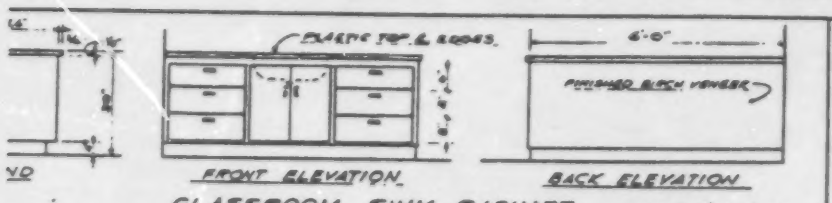
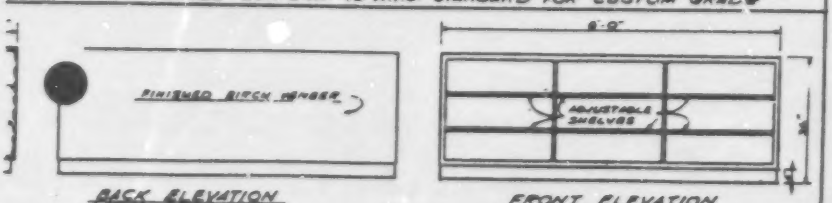
ROOF FRAMING PLAN SCALE 1/4" = 1'-0"



CLASSROOM SINK CABINET SCALE 1/2" = 1'-0"

DETAILS SHALL CONFORM TO W.I.C. STANDARD FOR CUSTOM GRADE



BOOKSHELVES SCALE 1/2" = 1'-0"

DETAILS SHALL CONFORM TO W.I.C. STANDARDS FOR CUSTOM GRADE

BASE MOLDING FULL SIZE

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C.L. BATOUGH, ARCHITECT

DATE: FEBRUARY 1963

APPROVALS

ROOF FRAMING, STRUCTURAL DETAILS AND MILLWORK DETAILS

ONE ROOM ELEMENTARY SCHOOL

7

FIXTURE SCHEDULE

FIXTURE	SYMBOL	WASTE BRANCH	WASTE OUTLET	VENT	COLD WATER BRANCH	COLD WATER OUTLET	HOT WATER BRANCH	HOT WATER OUTLET
Water closet	W.C	4"	4"	2"	1"½	1"		
Lavatory	L	2"	1½"	1½"	½"	½"	½"	½"
Urinal	U.R.	2"	2"	1½"	1"	½"		
Service Sink	S.S	3"	3"	2"	½"	½"	½"	½"
Floor drain	F.D	2"	2"	2"				
Hose bibb	H.B				½"	½"		
Sink	S	2"	1½"	1½"	½"	½"	½"	½"

PLUMBING LEGEND

———	Soil. waste above grade
— — —	Soil. waste below grade
- - - - - -	Sanitary vent
———	Cold water
———	Hot water
V - VR - VTR	Vent. vent riser. vent thru roof.
HWR (D)	Hot water riser (drop)
CWR (D)	Cold water riser (drop)
C.O.T.R	Cleanout thru floor
C.O.T.G.	Cleanout to grade
U.F.	Under floor
O.H	Overhead
C.I.	Cast iron
W.D	Waste drain

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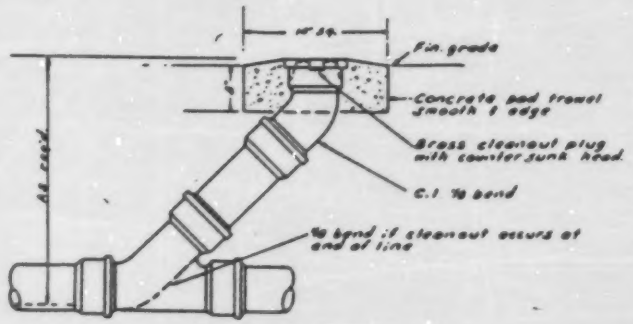
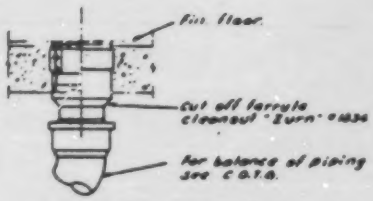
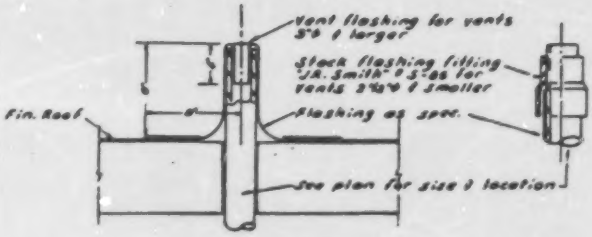

Fin. grade
Concrete pad trowel smooth & edge
Brass cleanout plug with counter sunk head
C.I. ⅛ bend
⅛ bend if cleanout occurs at end of line

C.O.T.G.

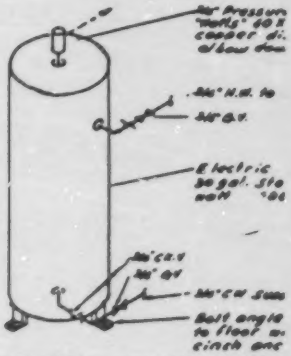


C.O.T.F.

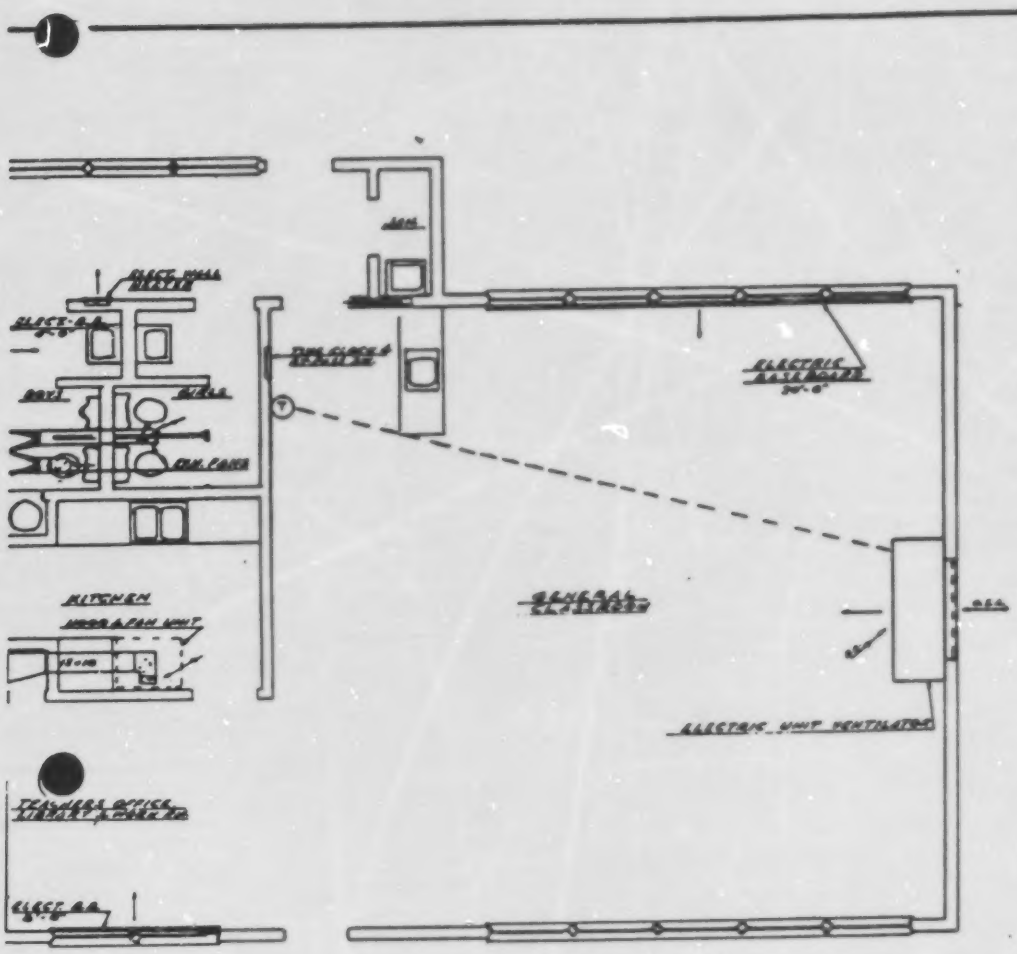
CLEANOUT DETAILS (A)
SCALE 1½" = 1'-0"


Vent flashing for vents 3" & larger
Stock flashing fitting "A.A. Smith" 0 S-05 for vents 2"&3" & smaller
Fin. Roof
Flashing as spec.
See plan for size & location

VENT PIPE FLASHING (B)
SCALE 1½" = 1'-0"



ELECTRIC WATERHEA
SCALE 1½" = 1'-0"



FLOOR PLAN SCALE ¼"=1'-0"

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C. L. EATOUGH, A/C ARCHITECT

DATE: FEBRUARY, 1943

APPROVALS

HEATING & VENTILATING

ONE ROOM ELEMENTARY SCHOOL

8

LESTER A. O'NEARA, INC.

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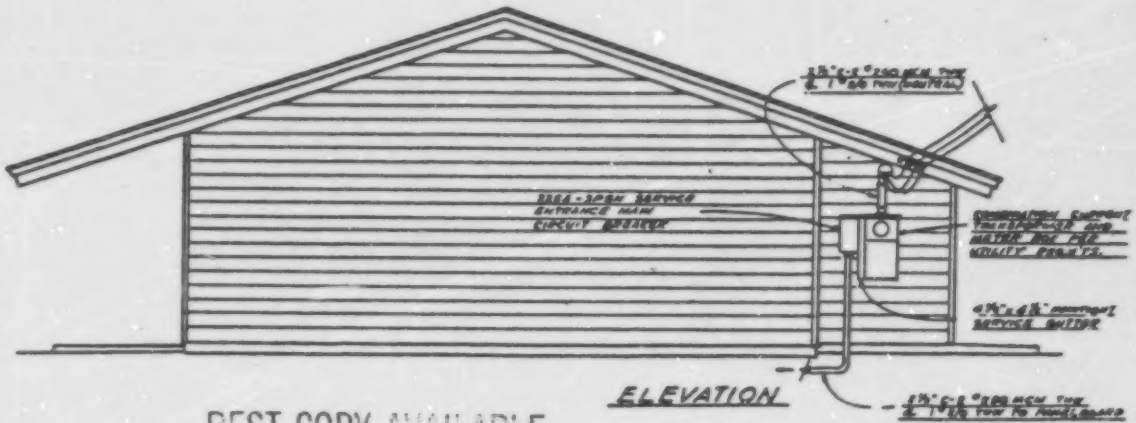

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FIXTURE SCHEDULE

FIXTURE SYMBOL	MANUFACTURER	CATALOG NUMBER	LAMPS	MOUNTING	REMARKS
(A)	SUNBEAM	P132/48C-98RS	6-F96T12/HO/WW	SUSP. TO 8'-0"	
(B)	SUNBEAM	P132/48A-98RS	2-F96T12/HO/WW	SUSP. TO 8'-0"	
(C)	SUNBEAM	P1801/48RS	4-F40/T12/WW	CEILING	
(D)	SUNBEAM	P3702/48RS	2-F40/T-12/WW	CEILING	
(E)	PRESCOLITE	1010 - 6614	1-100A	RECESSED	W/SNAP IN SCREWS & PLASTER FRAME
(F)	HOLOPHANE	415	1-100A	WALL	
(G)	CROUSE HINDS	ARB 31	1-60A	CEILING	WITH OPAL GLOBE

SYMBOL SCHEDULE

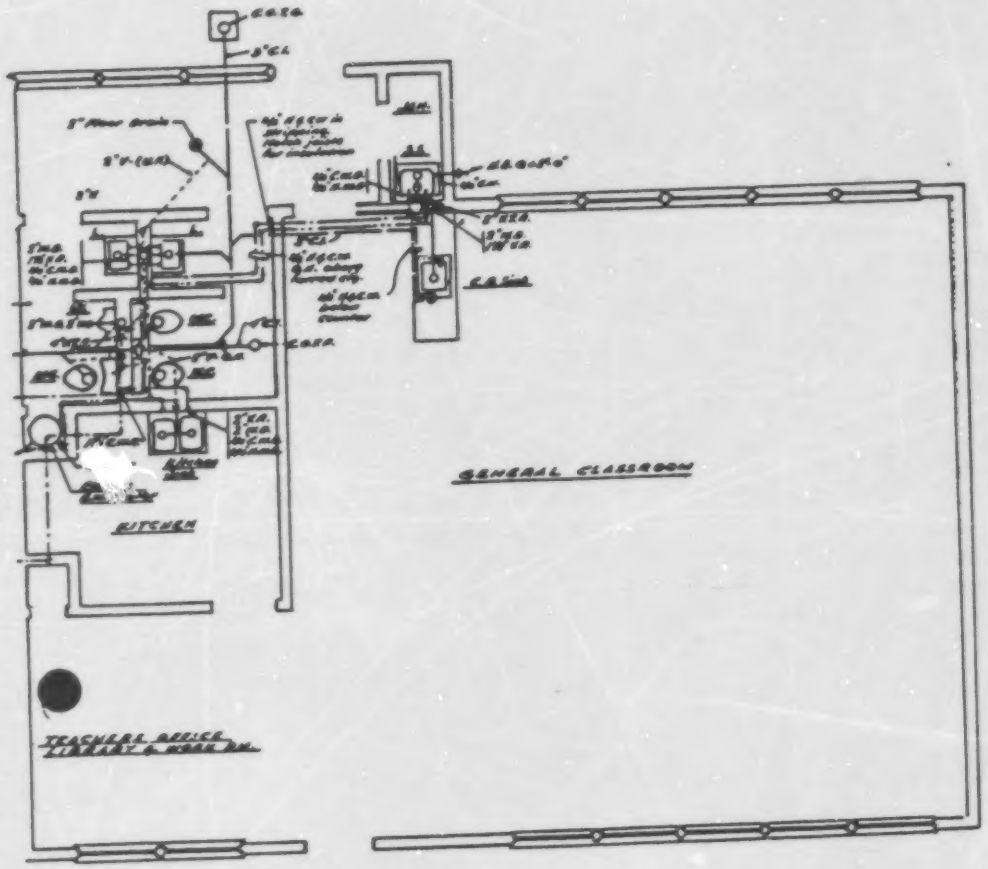
- FLUORESCENT LIGHTING FIXTURE
- INCANDESCENT FIXTURE - CEILING MOUNTED
- INCANDESCENT FIXTURE - RECESSED
- INCANDESCENT FIXTURE - WALL MOUNTED
- SINGLE POLE TOGGLE SWITCH @ 48" UNLESS NOTED OTHERWISE
- THERMAL OVER SWITCH, SIZE AS REQUIRED, @ 6'-0" UNLESS NOTED, KEY OPERATED.
- SWITCH SUBSCRIPTS : a - LTS SWITCHED, k - KEY OPERATED.
- SPEED SWITCH. SUPPLIED BY MECHANICAL CONTRACTOR, CONNECTED BY ELECT. CONTR.
- DUPLEX RECEPTACLE @ 18" UNLESS NOTED. (A & N #5252)
- CLOCK OUTLET (A & N #5708)
- JUNCTION BOX, SIZE AS REQUIRED.
- BASE BOARD HEATER, NOT IN ELECTRICAL CONTRACT, CONNECTED BY ELECT. CONTRACTOR
- WALL HEATER
- UNIT VENTILATOR TIME CLOCK & BY-PASS SUPPLIED BY MECH. CONTR. CONNECTED BY ELECT. CONTR.
- MOTOR. N.I.E.C., CONNECTED BY ELECT. CONTR.
- CONTROL EQUIPMENT. N.I.E.C., CONNECTED BY ELECT. CONTR.
- PANEL BOARD
- CONDUIT RUN CONCEALED IN FLOOR.
- CONDUIT RUN CONCEALED IN CEILING OR WALL
- RANGE OUTLET 50 AMP 4 WIRE RECEPTACLE & PLATE (A & N #5152) AND CORD SET (A & N # 5714A)
- THERMOSTAT N.I.E.C., CONNECTED BY ELECT. CONTR.
- HOMERUN TO PANEL BOARD. ANY CIRCUIT WITHOUT FURTHER DESIGNATION INDICATES A 2-#12 WIRE CIRCUIT. B-#12 WIRE IS SHOWN AS —o— ; 4-#12 WIRE AS —o— ; ETC. OTHER WIRE SIZES SHOWN AS FOLLOWS : —o— 3-#10; —o— 4-#8; —o— 3-#6; ETC.

PANEL BOARD

WESTINGHOUSE TYPE NQC-NDP-3L SEE PLUSH WITH

14-20A-1P CBR	CIRCUITS	1 THRU 13
4-20A-2P CBR	CIRCUITS	14, 15, 17
1-30A-2P CBR	CIRCUIT	16
1-50A-3P CBR "E" FRAME	CIRCUIT	18
1-100A-3P CBR "E" FRAME	CIRCUIT	19

FULL HINGED LOCKABLE DOOR 20" WIDE MINIMUM



FLOOR PLAN SCALE ¼"=1'-0"

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C. L. EATOUGH, ARCHITECT

DATE: FEBRUARY, 1963

APPROVALS

LESTER A. ONKEN

PLUMBING

ONE ROOM ELEMENTARY SCHOOL

9

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...ressured temp. relief valve
...0 GAL run for hard temp
...or discharge to outside
...w down @ 6"/8" above grade

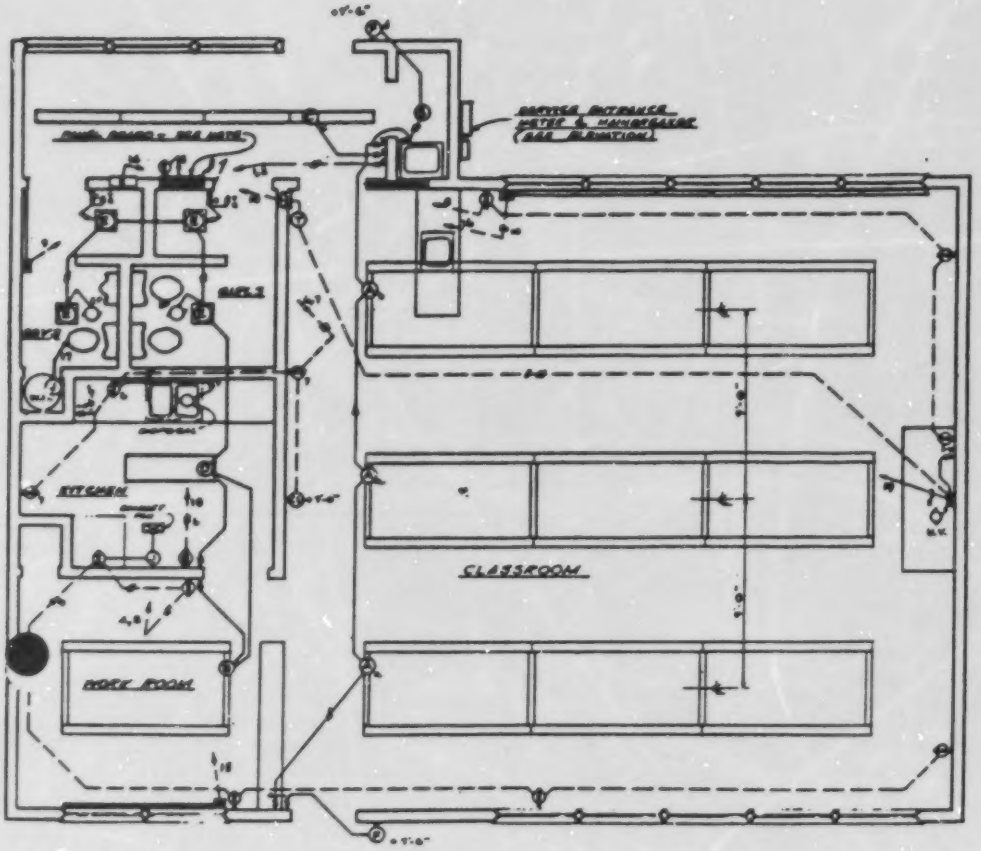
...to sink.

...tric waterheater "MODEL" 5-80
...gl storage ...gph recovery 50%
...Cap. 10

...r supply
...angle clips to legs and fasten
...oof with ½"ø bolts @ 2 unit
...h anchors

...EATER DETAIL

©



FLOOR PLAN

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APPROVALS

ELECTRICAL

ONE ROOM ELEMENTARY SCHOOL

10

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Self Assessment

After you have read the Information material, answer the questions below, referring to the working drawings at the back of the module as directed. Write each answer in the space provided at the right of the question.

LOOK AT THE AREA MAP ON SHEET 1, AND ANSWER QUESTIONS 1-2.

1. In what county is the school to be located? _____

2. What scale is used for the area map? _____

LOOK AT THE SITE DEVELOPMENT PLAN ON SHEET 1, AND ANSWER QUESTIONS 3-4.

3. What are the dimensions of the asphalt play area? _____

4. The main entrance to the school faces in what direction? _____

LOOK AT THE FOUNDATION PLAN ON SHEET 2, AND ANSWER QUESTIONS 5-9.

5. Anchor bolts of what size are to be used to fasten the sill to the pad? _____

6. What is the scale of the foundation plan? _____

7. Bolts of what size are to be used to anchor the foot scrapers? _____

8. How thick is the floor slab? _____

9. What is the height from the slab to the top of the plate? _____

LOOK AT THE FLOOR PLAN AND ELEVATIONS ON SHEET 3, AND ANSWER QUESTIONS 10-12.

10. What material is to be used for the exterior siding? _____

11. How many exterior doors are there? _____

12. Approximately how many square feet of floor area does the teacher's office have? _____

LOOK AT THE DOOR AND WINDOW DETAILS ON SHEET 4, AND ANSWER QUESTIONS 13-14. REFER AGAIN TO PREVIOUS SHEETS AS NECESSARY.

13. What material is specified for the outside doors? _____

14. What type of door is specified for the kitchen? _____

LOOK AT THE INTERIOR ELEVATIONS ON SHEET 5, AND ANSWER QUESTION 15.

15. What material is to be used to finish the walls in the coatroom? _____

LOOK AT THE STRUCTURAL FRAMING AND ROOF FRAMING SECTIONS (SHEETS 6 AND 7), AND ANSWER QUESTIONS 16-17.

16. Nails of what size are to be used on the roof sheathing? _____

17. How deep is the classroom sink cabinet from front to back? _____

LOOK AT THE HEATING AND VENTILATING, PLUMBING, AND ELECTRICAL PLANS (SHEETS 8, 9 AND 10), AND ANSWER QUESTIONS 18-20.

18. In what room is a thermostat to be located? _____

19. What means of ventilation is provided in the lavatories? _____

20. In how many places are hot water taps to be located? _____

Self Assessment Answers

1. trinity
2. 1" = 30'
3. 75' x 65'
4. south
5. 3/4"
6. 1/4" = 1'
7. 1/2" x 8"
8. 4"
9. 6"
10. 1" x 8" redwood
11. two
12. 175 sq. ft.
13. weldwood
14. solid core birch surface
15. horizontal redwood siding
16. 8d
17. 24"
18. general classroom
19. 12" x 24" louvred opening
20. three

Post Assessment

Listed below each numbered item are four possible answers or completing phrases. Decide which of the four is correct, or most nearly correct; then write the corresponding letter in the blank space to the left of that item.

1. ____ Which one of the following kinds of information could a worker expect to find in a set of working drawings for a building?

   a. grades of lumber to be used
   b. quality of paint required
   c. separate sheets of details for the different crafts
   d. the time limit for completion of the project

2. ____ Which one of the following kinds of information would normally appear in the specifications for a building?

   a. locations of utilities at the site
   b. quality of plumbing fixtures required
   c. dimensions of footings
   d. grade contours

3. ____ On which one of the following kinds of working drawings could a carpenter expect to find information about roof structure?

   a. plot plan
   b. exterior elevations
   c. foundation plan
   d. floor plan

4. ____ The arrangement of rooms is shown on a:

   a. site development plan
   b. floor plan
   c. detail drawing
   d. shop drawing

5. ____ The symbol (T) on an electrical plan indicates a:

   a. timer
   b. thermostat
   c. duplex receptable
   d. junction box

6. ____ A chart appearing on a working drawing giving the names, sizes, and manufacturers of special equipment is called a:

   a. schedule
   b. specification
   c. detail
   d. cross section

7. ____ Before placing electrical outlets in a new building, the electrician will consult the:

   a. architect
   b. general contractor
   c. building superintendent
   d. electrical plan

8. ____ A characteristic of a plan view (floor plan or foundation plan) is that it:

   a. shows more detail than any other type of working drawing
   b. shows the interior construction of partitions
   c. reveals the structure as it would be viewed from above
   d. includes all necessary specifications for the project

9. ____ An exterior elevation is a view of one side or face of a building from a viewpoint:

   a. slightly above and to the right of the side shown
   b. slightly below and to the left of the side shown
   c. directly in front of the side shown
   d. that reveals the maximum number of building details

10. ____ Contour lines are normally found on the:

   a. plot plan
   b. foundation plan
   c. floor plan
   d. elevations

3.3

SCALING AND DIMENSIONING

Goal:

The apprentice will be able to describe the concepts of scaling and dimensioning as applied to blueprints.

Performance Indicators:

1. Describe scales.
2. Describe dimensions.

Study Guide

For successful completion of this module, complete the tasks in the order listed below. Check each one off as you complete it.

1. ____ Read the Goal and Performance Indicators on the cover of this module. This will explain what you can be expected to learn from the module and how you will demonstrate it.

2. ____ Read the Introduction section and study the Information section. In these sections you will acquire the knowledge necessary to pass the Self and Post Assessment exams.

3. ____ Complete the Self Assessment exam. This will show you how well you can expect to do on the Post Assessment exam. Compare your answers with those on the Self Assessment Answer Sheet found immediately following the exam. If you scored poorly, re-study the Information section or ask your instructor for help.

4. ____ Complete the Post Assessment exam. Turn the answers in to your instructor. It is recommended you score 90% or better before continuing with the next module.

Introduction

Full-size (full-scale) working drawings are often used for the graphic representation of small technical objects or their parts. Most working drawings for large projects, however, are made to a reduced size or scale, each line being drawn a fraction of the actual length it represents.

In general, all the dimensions needed to fabricate, assemble, or inspect the object will be given on a well-executed working drawing, and they will be presented in a way that is convenient for the worker. If he or she has a thorough understanding of the conventions used by the draftsperson, the user should seldom find it necessary to determine any dimensions by calculation or by scaling (using an architect's scale or a rule to take a measurement directly off the drawing). Calculation is the preferred method for determining an unknown dimension on a working drawing; because of errors that might arise from such factors as shrinkage or expansion of the paper, scaling is not recommended.

Information

SCALE

The scale of a drawing is the ratio of drawing dimensions to object dimensions. The choice of scale for a working drawing depends on convenience, the space available on the sheet, and the amount of detail that must be shown. The scale used is always indicated on the drawing. A machine part may be drawn half size; in this case, the drawing would be made to half scale, which would be indicated as 1/2" = 1'. Floor plans and exterior elevations for buildings are often drawn 1/48th size, or to a scale of 1" = 10'0". A single scale is employed for every part of a given drawing; however, different scales may be used for other drawings in the set.

The measuring devices used in the making of scale drawings are known as "scales." Commonly used instruments of this type include the architect's scale, the engineer's scale, and the mechanical draftsperson's scale. The architect's scale is the type used to lay out drawings of buildings and their components. (See Fig. F-3.) A triangular architect's scale of the type illustrated has on its three faces a total of ten reduced-size scales ranging from 3/32" = 1'0" to 3" = 1'0". One face also has a full-size scale in inches, like that of a standard ruler.

The technique of measurement with an architect's scale is illustrated in Fig. F-4. The unknown dimensions A-B is to be determined on a drawing having a scale of 1/4" = 1'0". The architect's scale is placed on the drawing as shown, with the scale mark corresponding to the largest number of whole feet in the dimensions (10 ft. in this instance) directly under extension line A. Extension line B will then fall on the short graduated scale that extends to the right of zero. Each of the small graduations to the right of zero represents one inch on the 1/4" = 1'0" scale; the dimensions A-B in the given problem is therefore 10 ft. 9 in. If an unknown dimension is 12 in. or less, it can of course be read directly from the short inch scale.

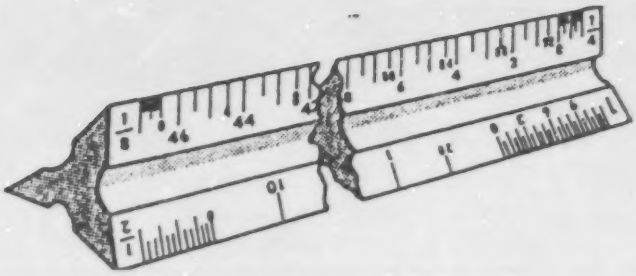


Fig. F-3. An architect's scale

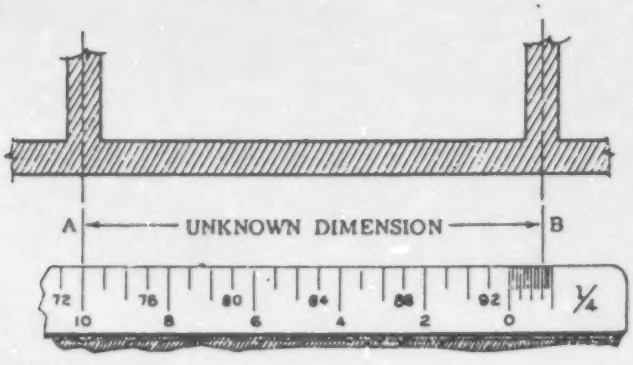


Fig. F-4. Using an architect's scale (1/4" = 1'0" scale)

DIMENSIONS

The drawing or shape-description of an object is incomplete without dimensions or size-description. Dimensions are located on working drawings by means of dimension lines and extension lines, which are light-bodied solid lines so placed on the drawing that they cannot be misinterpreted as being part of the object. Extension lines mark the beginning and the end of the distance for which a dimensions is shown; they extend at a right angle from the desired locations on the drawing, with a gap of about 1/16 in. between the extension line and the drawing. Dimension lines indicate the distance between two points, usually between two extension lines; they are placed outside the drawing of the object whenever possible. Dots or arrows (the latter uniform in size and shape, about 1/8 in. long and narrow) are placed at the ends of the line, and the numbers giving the dimensions are placed near the line, usually at the midpoint. (See Fig. F-5.)

An arc is dimensioned by giving its radius, as shown in Fig. F-6. A circle may be dimensioned by giving either its radius or its diameter; unless the reference is obvious, the dimension number should be followed by R or D, indicating radius or diameter. If the circle represents a hole that is to be drilled, bored, reamed,

or punched, its diameter is specified by a short note, which is connected to the circle by a line called a leader.

Fig. F-5. Dimensions and extension lines

Fig. F-6. Dimensioning an arc

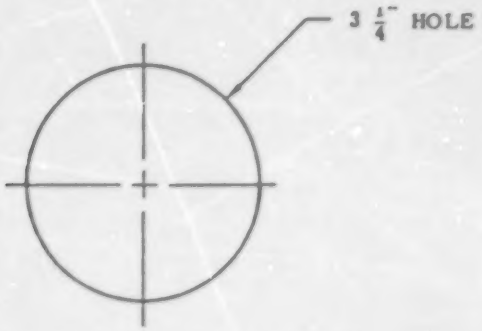


Fig. F-7. Dimensioning a hole

The placement of dimensions should be governed by two considerations: an orderly arrangement and convenience for the workers who are to consult the drawing. At times, space limitations or the necessity for keeping the drawing uncluttered make it necessary to omit one or more dimensions; in this case, the draftsperson will include all the dimensions most needed for understanding the drawing, relying on the worker to calculate omitted dimensions from those given.

Self Assessment

Read each statement and decide whether it is true or false. Write T if the statement is true; write F if the statement is false.

1. ____ The scale of a working drawing is the ratio of the drawing size to the object size.

2. ____ All the drawings in a set are made to the same scale.

3. ____ Dimension lines and extension lines are drawn lighter than the lines of the object.

4. ____ Dots or arrows are used to mark the ends of dimension lines.

5. ____ An architect's scale is a four-sided instrument.

6. ____ An arc may be dimensioned by giving its radius or its diameter.

SELF ASSESSMENT ANSWER SHEET

1. T

2. T

3. T

4. T

5. F

6. F

Post Assessment

Listed below each numbered item are four possible answers or completing phrases. Decide which of the four is correct, or most nearly correct; then write the corresponding letter in the blank space to the left of that item.

1. ____ The scale of a drawing is the ratio of:

   a. width to height
   b. height to width
   c. drawing dimensions to object dimensions
   d. object dimensions to drawing dimensions

2. ____ If an object is drawn 1/48th size, the scale of the drawing is:

   a. 1/48" = 1'0"
   b. 1/4" = 1'0"
   c. 4" = 48"
   d. 48" = 4'0"

3. ____ On a site development plan drawn to a scale of 1" = 10'0", a 40' x 80' building would be drawn:

   a. 2" x 4"
   b. 4" x 8"
   c. 12" x 24"
   d. 40" x 80"

4. ____ The scale of a working drawing can be determined by:

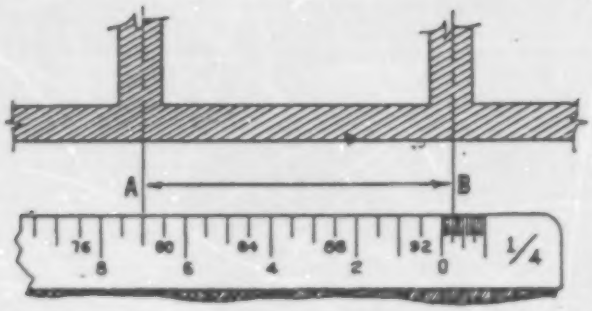
   a. inspecting the drawing on which the scale used will be specified
   b. consulting the contractor
   c. looking under "scale" in the specifications
   d. dividing any given dimension by 48

5. ____ When some dimensions must be omitted in the making of a working drawing, the ones given should be:

   a. those that will best fit in the available space
   b. those most needed for understanding the drawing
   c. the smaller dimensions
   d. the larger dimensions

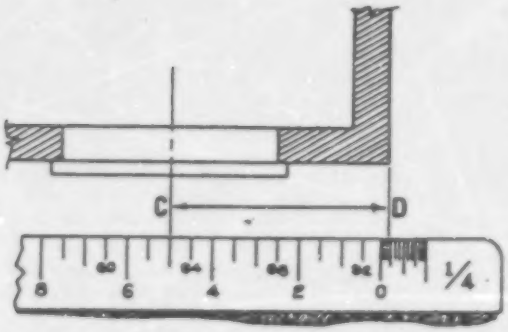
6. ____ The dimension A-B in the drawing below, as indicated on the architect's scale is:

a. 6'0-1/4"
b. 6'4"
c. 7'3"
d. 8'3"



7. ____ The dimension C-D in the drawing below, as indicated on the architect's scale is:

a. 4'8"
b. 5'2"
c. 5'8"
d. 6'8"

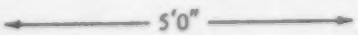


8. ____ A hole is to be drilled in a part. How can the dimensions of the hole be indicated most conveniently on a drawing of the part?

a. by providing complete written instructions for locating and making the hole
b. by dimensioning the material on both sides of the hole
c. by a brief note connected by a leader to the hole
d. by drawing an extension line from each side of the hole

9. ____ The line shown below is a(n):

a. extension line
b. dimension line
c. break line
d. scale line



3.4

SKETCHING

Goal:

The apprentice will be able to describe sketching.

Performance Indicators:

1. Describe uses of sketches.
2. Describe materials for sketching.
3. Describe size and proportions for sketches.
4. Describe sketching procedures.
5. Describe sketching lines.
6. Describe basic forms of sketching.

Study Guide

For successful completion of this module, complete the tasks in the order listed below. Check each one off as you complete it.

1. ____ Read the Goal and Performance Indicators on the cover of this module. This will explain what you can be expected to learn from the module and how you will demonstrate it.

2. ____ Read the Introduction section and study the Information section. In these sections you will acquire the knowledge necessary to pass the Self and Post Assessment exams.

3. ____ Complete the Self Assessment exam. This will show how well you can expect to do on the Post Assessment exam. Compare your answers with those on the Self Assessment Answer Sheet found immediately following the exam. If you scored poorly, re-study the Information section or ask your instructor for help.

4. ____ Complete the Post Assessment exam. Turn the answers in to your instructor. It is recommended you score 90% or better before continuing with the next module.

Introduction

For the skilled worker, the importance of being able to make quick, clear and accurate sketches cannot be overemphasized. Most mechanical and architectural ideas are expressed better by means of a sketch than by a verbal description. In general, once a technical problem has been put down as a picture, it is more clearly defined and its complications become more obvious. In some instances, sketches may take the place of regular working drawings; for example, a shop sketch made by the foreman or a journeyman may be the only drawing for a small job that is to be done in the shop.

In learning to sketch, the apprentice will not only acquire a needed job skill; he or she will also develop the ability to observe things more critically. Making an accurate sketch of an object requires that all its details and parts relationships be carefully studied and clearly understood.

Information

USES OF SKETCHES

The degree of perfection and the amount of detail required in a given sketch depends upon its intended use. Sketches made to organize ideas, or to develop or formulate various solutions to a given problem, may be rough or incomplete. An architect's quickly drawn preliminary floor plan, showing his or her ideas for room arrangement, is a good example of such a rough sketch. On the other hand, sketches intended for communicating important information in a precise way should be very carefully done. An example of this would be a detail sketch developed from an existing drawing, possibly to show necessary changes in construction or to give detailed information about size, materials, and installation.

MATERIALS FOR SKETCHING

The materials required for making sketches are few--usually only a pencil, some paper, and an eraser. The pencil should have a rather soft lead--a No. 2 in the ordinary pencil series or an HB or F in the drafting pencil series. End views of various drafting pencils, ranging from the very hard 9G to the very soft 7B, are illustrated in Fig. F-8. The harder drafting pencils are used where high accuracy is required; medium pencils are used for general sketching and lettering; and the softer pencils are used for making large freehand drawings. (Coordinate paper, which has crossed lines or grids, is helpful to the beginner; the grids may be used as guides for drawing lines and keeping proportions. The grids of such paper are either rectangular or isometric. (See Fig. F-9.)

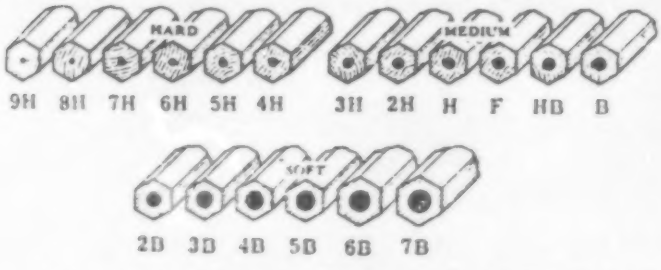


Fig. F-8. Hard, medium & soft drafting pencils

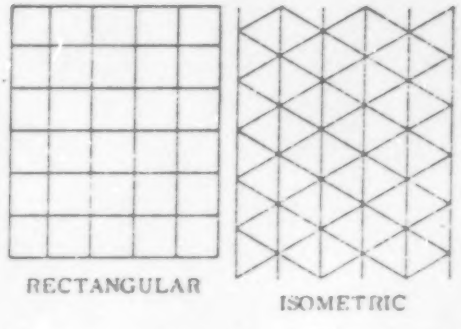


Fig. F-9. Grids of coordinate paper

SIZE AND PROPORTIONS OF SKETCHES

In general, sketches are not made to any scale, but they should be as nearly in proportion as possible. Before a sketch can be started, the overall dimensions of the object to be drawn must be known; the size of the sketch can then be planned in accordance with the area available for it on the paper. When the desired size for the sketch has been determined, the proportions can be worked out from the dimensions of the object. In working out proportions, it is helpful to ask oneself questions like these: How many times greater is the height than the width (or vice-versa) of the object? If the object has openings, are their height and width greater then the spaces between them?

SKETCHING PROCEDURES AND TECHNIQUES

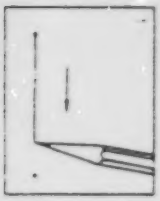
The term "sketch" is often misunderstood to mean a vague, crude drawing; however; if even a rough sketch is to be of any value, it must be done with reasonable care and accuracy. Speed in sketching is desirable, but the beginner should concentrate at first on developing accuracy. He or she should hold the pencil in the normal writing position, using wrist motion for sketching the shorter lines and forearm motion for the longer ones. All lines should be drawn with a free movement, without hesitation, and fairly fast.

SKETCHING LINES

A group of exercises designed to develop skill in the sketching of lines is given on the next page. In doing these exercises, the apprentice should connect the dots in each set as shown, making each line with one firm, quick stroke and keeping his or her eye on the dot toward which the pencil is moving--not on the pencil point. Short, "hairy" strokes must be avoided; the pencil should be kept in contact with the paper for the entire length of the stroke. If the resulting line looks wavy, it was probably drawn too slowly; if the line misses the dots, it was probably drawn too fast. It is good practice to go through the motion of the stroke once or twice with the pencil raised slightly off the paper before actually drawing the line; when the stroke seems to be going where it should, the pencil point can be lowered onto the paper and the final stroke made.

EXERCISES IN SKETCHING LINES

HORIZONTAL



VERTICAL

DIAGONAL

DIAGONAL

CURVED

BASIC FORMS IN SKETCHING

When you have become proficient in the freehand drawing of lines, you will be ready to try sketching the basic geometric forms--squares, rectangles, triangles, and circles--that singly or in various combinations represent the shapes of most objects.

Two simple ways to sketch rectangles or squares when the lines are parallel to the paper edge are shown in Fig. F-10. In the method illustrated at the left, points are laid out the required distance in from the paper edges, then connected with freehand pencil strokes. A strip of paper or cardboard can be marked and used as a gage for laying out the points. The method illustrated at the right can be employed if a sketching pad is being used; the pencil is held as shown, the fingertips being used to guide the hand along the edge of the pad.

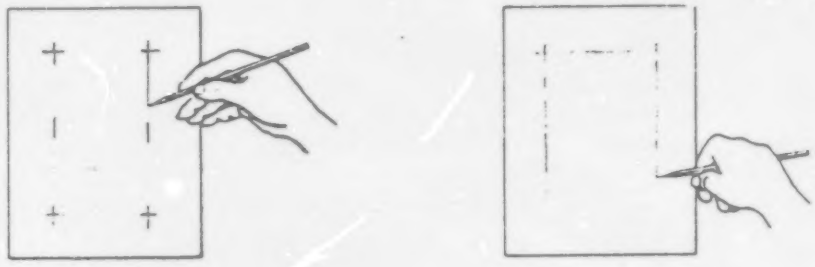


Fig. F-10. Two methods of sketching lines parallel to the paper edge

The sketching of squares, rectangles, triangles, and circles is made easier by laying them out on crosses (intersecting lines) that have been marked to provide reference points for the drawing. (See Fig. F-11.)

Circles and arcs, especially the larger ones, may also be drawn with fair accuracy by placing the tip of the little finger on the paper where the center of the circle will come, holding the pencil steady and with moderate pressure on the paper, then rotating the paper carefully. (See Fig. F-12.)

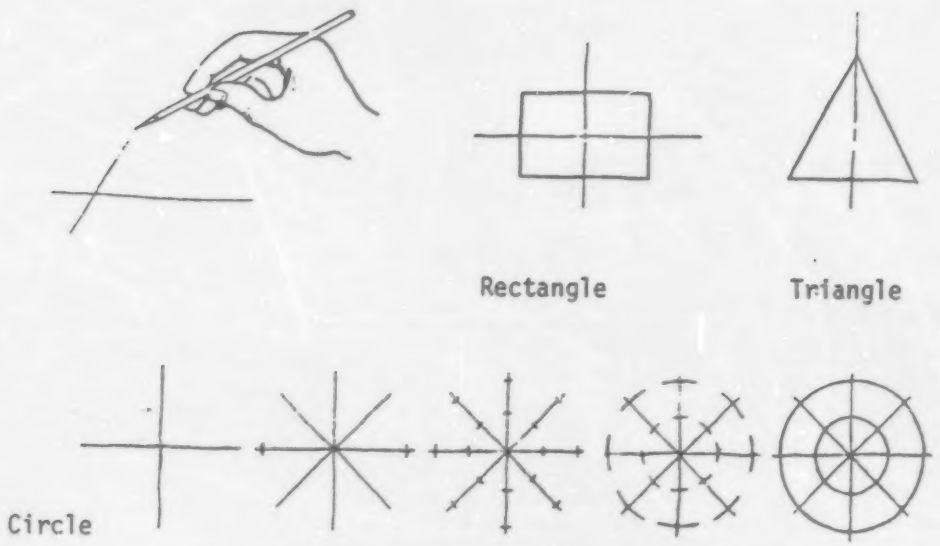


Fig. F-11. Laying out figures from center lines

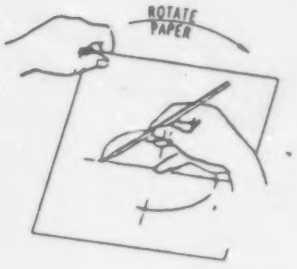


Fig. F-12. Another method of drawing a circle

Self Assessment

Read each statement and decide whether it is true or false. Write T if the statement is true; write F is the statement is false.

1. ____ Sketching an object may compel a person to change his or her opinion of it in some way.

2. ____ A sketch developed from an existing drawing to show a change in construction should be very carefully done.

3. ____ To make a good-quality line for a sketch, one should use short, overlapping pencil strokes.

4. ____ Sketches are usually made to some given scale.

5. ____ Lines are employed in sketching to represent the surfaces, edges, and contours of objects.

6. ____ Most right-handed persons find that the most natural direction for drawing horizontal lines is from left to right.

7. ____ A ruler is an essential instrument in freehand sketching.

8. ____ If the lines of a sketch are wavy, they were probably drawn too fast.

SELF ASSESSMENT ANSWER SHEET

1. T
2. T
3. F
4. T
5. T
6. T
7. F
8. F

Post Assessment

Listed below each numbered item are four possible answers or completing phrases. Decide which of the four is correct, or most nearly correct; then write the corresponding letter in the blank space to the left of that item.

1. ____ Learning to sketch develops a technical student's ability to:
   a. use drafting instruments
   b. understand verbal instructions
   c. observe things critically
   d. use the tools of his or her trade

2. ____ Which of the following combinations of materials would be best for the beginner in sketching?
   a. coordinate paper
   b. charcoal and wood
   c. unlined paper and any soft pencil having an eraser
   d. typing paper, typewriter eraser, and HB drafting pencil

3. ____ In drawing a line freehand, one should use:
   a. a series of short, overlapping strokes
   b. a straightedge if the line is over 4" long
   c. wrist motion only
   d. a single pencil stroke

4. ____ The first step in learning to sketch is to practice drawing:
   a. lines
   b. rectangles
   c. planes and contours
   d. three-dimensional forms

5. ____ Coordinate tracing paper has:
   a. no lines
   b. vertical lines only
   c. horizontal lines only
   d. crossed lines or grids

6. ____ Sketches are usually made:

a. to scale and in proportion
b. to scale but not in proportion
c. neither to scale nor in proportion
d. in proportion but not to scale

7. ____ The first step in making a sketch is to:

a. draw the lines representing the top and bottom of the object
b. draw the lines representing the sides of the object
c. determine the overall dimensions of the object
d. determine all the dimensions of the object

8. ____ The degree of perfection and the amount of detail required in a sketch depends upon the:

a. number of copies to be made
b. importance of the information given in the sketch
c. time available for sketching
d. cost of the item beirg sketched

9. ____ Which one of the following is essential equipment for sketching?

a. drafting instruments
b. coordinate paper
c. blueprint machine
d. soft eraser

10. ____ If a freehand-drawn line looks wavy, it probably was drawn:

a. with too soft a pencil
b. one the wrong paper
c. too rapidly
d. too slowly

INSTRUCTIONAL LEARNING SYSTEMS

3.5

MACHINE AND WELDING SYMBOLS

Goal:

The apprentice will be able to identify common symbols in a working drawing.

Performance Indicators:

1. Identify machine symbols.
2. Identify welding symbols.

Study Guide

In order to successfully complete this module, do the following tasks in the order in which they are presented. Check them off as you complete them.

1. ____ Familiarize yourself with the Goal and Performance Indicators presented on the cover of this module. This will inform you of what you are expected to gain from the study of this module, as well as how you will be expected to demonstrate your competence.

2. ____ Study the Information section. This will provide you with the knowledge necessary to complete the Self and Post Assessment exams.

3. ____ Complete the Self Assessment exam, referring to the Information section or asking your instructor when necessary. Compare your answers with those found on the Self Assessment Answer Sheet immediately following the exam. This will demonstrate how well you can expect to do on the Post Assessment exam.

4. ____ Take the Post Assessment exam and turn your answers in to your instructor for grading. It is recommended that you score 90 percent or better before going on to another module.

Information

The fifth module of this section, "Working Drawings for Machining and Welding," explained that three elements are found in working drawings: lines, dimensions and symbols or notes. That module discussed lines and dimensions as they apply to the machine and metal trades; this module will discuss the symbols and notes.

MACHINE SYMBOLS

Machined materials most often must be ground to a desired degree of smoothness or roughness in order to meet the specifications called for by the draftsperson.

Surface finish symbols are as follows:

✓ or V = smooth finish, with the following letters placed in the V

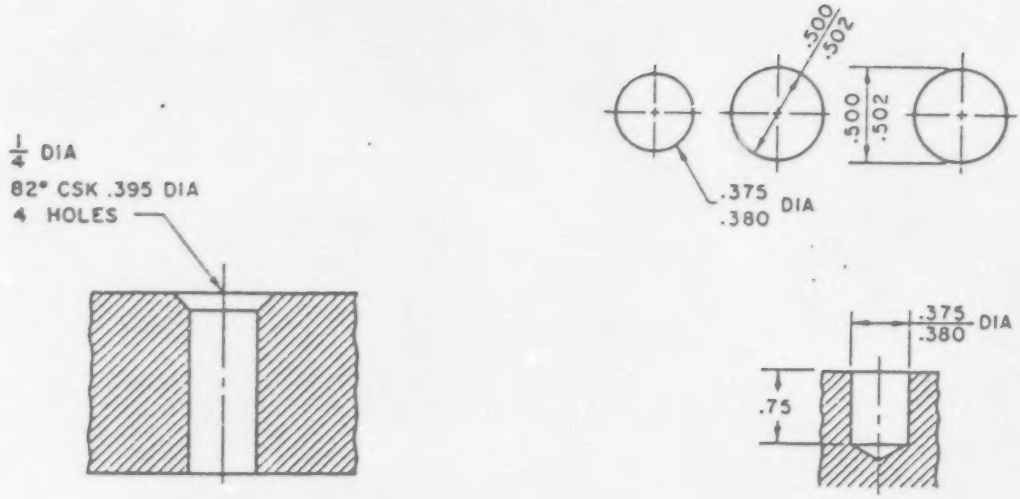
R = rough machining

S = smooth machining

G = ground surface

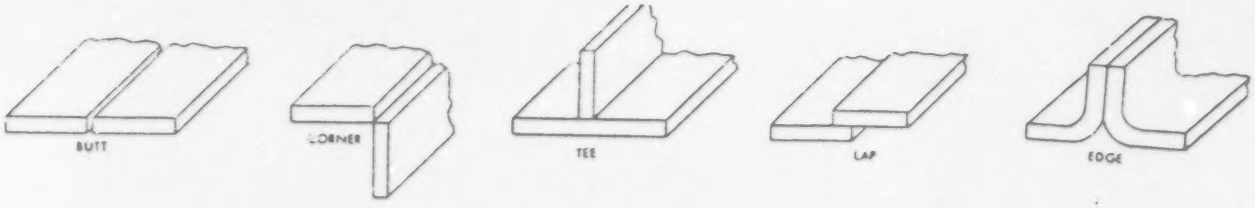
When the surface is to be more exactly controlled than simply a rough or smooth designation, the check mark (✓) with a number placed in it is used. The number refers to the microinches (or millionths of an inch) of roughness height. An example: 55 , means that the machined surface can have flaws of only 55/1,000,000 in height or depth.

In addition to surfaces, holes for keys, bolts and screws must also be specified in many machined parts. Several typical hole drawings and dimensions are shown below in figure H-1.



WELDING SYMBOLS

There are two important factors which welding symbols provide. First, the symbols point out the type of weld to be made; secondly, they point out on what side or sides of a joint that particular type of weld is to be made. Figure H-2 illustrates the common types of weld joints.



Certain types of welds may be used on each of these basic joints. The common types of welds include seam, groove, flange, fillet, spot and others. Each of these types has its own specific symbol. The spot weld symbol is a circle: ○ ; the seam weld symbol is a circle with horizontal lines through it: ⊖ ; the fillet weld symbol is a right triangle: △ ; and so on. It is not the intention here to present all of them; seek complete information from this module's Supplementary Reference section.

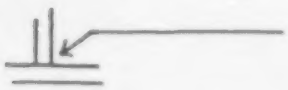
The second main factor in welding symbols, you will recall, is the symbol used to point out the location of the weld, or on which side of the joint the weld is to

be made.

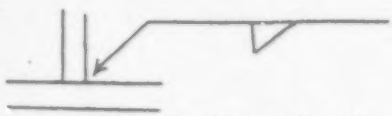
The main part of a welding symbol is the reference line with an arrow at one end.

Example:

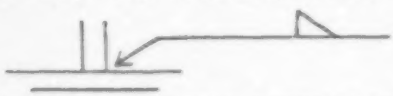
The location of the weld is pointed out by the arrow, like this:



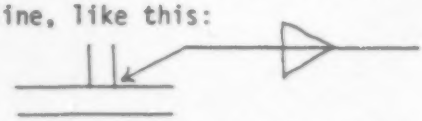
If the weld is to be made on only the side the arrow is pointing to, the appropriate weld symbol (in this instance, we'll assume it to be a fillet weld) will be placed below the reference line, like this:



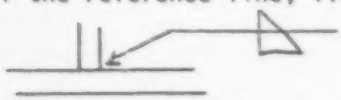
If the weld is to be made on the side opposite of where the arrow is pointing, the appropriate symbol will be placed above the reference line, like this:



If the weld is to be made on both sides, then the appropriate symbol will be placed both above and below the reference line, like this:



If it doesn't really matter on which side of the joint the weld is to be made, the symbol would be placed in the middle of the reference line, like this:



Obviously, there are many more symbols and numbers used on and along the reference line to point out spacing of welds, size of welds or weld combinations, etc. Consult the Supplementary Reference section for more complete information.

Self Assessment

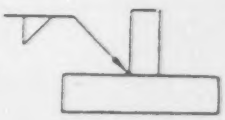
Decide if the following statements are true (T) or False (F) and place the appropriate letter in the space to the left of the statement.

1. ____ Machined materials never have finished surfaces.
2. ____ The term microinch refers to millionths of an inch.
3. ____ The symbol $\sqrt{S}$ indicates a rough finish is desired.
4. ____ Bolt hole dimensions are seldom given, relying usually on the letters B, F, or D.
5. ____ There are about 1,500,000 common weld joints.
6. ____ A lap joint refers to the fact that one piece overlaps another.
7. ____ The symbol for a spot weld is a circle.
8. ____ Welding symbols are different from all other symbols in that welding symbols have arrows on both ends of the reference line.
9. ____ The positioning of the welding symbol with respect to the reference line indicates where the weld is to be located.
10. ____ A butt joint means that one piece will be welded at a 90 degree angle to another piece.

SELF ASSESSMENT ANSWER SHEET

1. F
2. T
3. F
4. F
5. F
6. T
7. T
8. F
9. T
10. F

Post Assessment

1. What does this weld symbol indicate? _____ 

2. Sketch the correct symbol for a seam weld.

3. The symbol means that the surface must be machine smooth to a tolerance of 55 _____.

4. The main part of a welding symbol consists of a _____ and an arrow.

5. The letters R, S and G mean as follows:

   R =

   S =

   G =

"END OF DOCUMENT"